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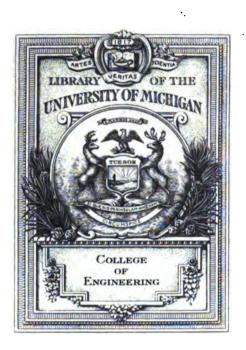
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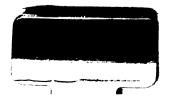
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SIXTH ANNUAL REPORT

OF THE

Jew zyork (STATE) WATER SUPPLY COMMISSION

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Compliments of

State Water Supply Commission

- II. River Improvement for the Protection of the Public Health and Safety.
- III. Water Storage and the Conservation of Water Power Resources.

ALBANY
J. B. LYON COMPANY, STATE PRINTERS
1911

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STATE OF NEW YORK

No. 19.

IN ASSEMBLY

JANUARY 31, 1911.

SIXTH ANNUAL REPORT OF THE STATE WATER SUPPLY COMMISSION.

ALBANY, January 31, 1911.

Honorable Daniel D. Frisbie, Speaker of the Assembly:

Dear Sir: In compliance with the requirements of Article 2 of the State Boards and Commissions Law the State Water Supply Commission herewith transmits to the Legislature its report for the year ending December 31, 1910.

Very respectfully,

HENRY H. PERSONS,
JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
ROBERT H. FULLER,

Commissioners.

NEW YORK STATE WATER SUPPLY COMMISSION.

HENRY H. PERSONS, President	East Aurora
John A. Sleicher	New York City
MILO M. ACKER	Hornell
Charles Davis	Saugerties
ROBERT H. FULLER	Albany
DAVID R. COOPER, Secretary	Alhany
DAVID II. Cooling, Scotton y	inoung
WALTER MCCULLOH, Consulting Engineer	Niagara Falls

Office of the Commission: Lyon Block, Albany.

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SIXTH ANNUAL REPORT.

ALBANY, N. Y., December 31, 1910.

To the Legislature:

The State Water Supply Commission herewith submits its Sixth Annual Report in accordance with the provisions of Article 2 of the State Boards and Commissions Law and the amendments thereto.

With its report the Commission includes the results of the further studies made during the past year as reported to the Governor in accordance with the provisions of chapter 569 of the Laws of 1907, appropriation for the continuance of this work having been made by the last Legislature.

Scope of the Report.

For clearness in presentation, the report deals separately with the following subjects:

- I. Municipal Water Supplies.
- II. River Improvement for the Protection of the Public Health and Safety.
- III. Water Storage and the Conservation of Water Power Resources.

Each of these subjects is closely related to the other two, and the best interests of the State require that each should be considered in connection with the others. I.

MUNICIPAL WATER SUPPLIES.

The Commission, in its Fifth Annual Report, which was submitted to your honorable body under date of February 1, 1910, included water supply applications made in the month of January, 1910. It has been deemed advisable, for the sake of uniformity, to confine the report to the calendar year. Accordingly, the present report includes all the applications made to the Commission during the year 1910 by municipalities, private water companies and individuals in accordance with the law, for permission to acquire new sources of water supply. During the year the Commission has received twenty-four applications under the Four made in 1909 awaited decision. The Commission granted twenty-three applications and refused its consent to one, for the reasons set forth in its decisions; two were discontinued. The applications made during the year represent a total investment of \$850,000, and contemplate a total water supply amounting to 9,000,000 gallons per day for the use of a population of 100,000 in various municipalities.

The number of petitions for permission to acquire new or additional sources of water supply made to the Commission during the past year exceeds that of any previous year by nearly two-thirds.

The most important application considered by the Commission was that of the City of New York for permission to complete its plan for obtaining a water supply from the Catskills by the construction of a distributing system in the city extending to all its boroughs. The application was in form a modification of the plans approved by the Commission on May 14, 1906. The original application contained a tentative plan for the distribution of the Catskill water in New York city by means of an aqueduct carried through the borough of The Bronx and under the East

river to the boroughs of Queens and Brooklyn. It was understood, however, when the original application was granted that this plan would be modified when there had been opportunity for more thorough surveys and investigations.

The application for the modification of the plans with respect to the distributing system was dated November 15, 1909, but owing to the change of administration in New York city and the desire of the incoming city officials to examine the plans before they were finally passed upon, action upon them was delayed at the request of the city. The plan as presented to the Commission originated with the board of water supply of the City of New York, and had the approval of the board of estimate and apportionment after a hearing had been given upon due notice. It contemplates the construction of a rock pressure tunnel from the Hill View reservoir at the northern boundary of the city. This tunnel will pass under the borough of The Bronx, the Harlem river, the borough of Manhattan for nearly its entire length, and the East river to the borough of Brooklyn. At its terminus the water will be delivered into surface mains, extending in one direction into the borough of Queens and in the other direction under the Narrows to the borough of Richmond, where a reservoir will be built to receive it. The rock pressure tunnel, which will be driven through solid rock at a depth of from two hundred to six hundred feet below the surface, will be capable of delivering the entire five hundred million gallons a day, or the maximum supply which the Catskill source is capable of furnishing. cost is estimated at \$25,000,000, and four or five years will be required to complete it. The deep tunnel will be about seventeen miles long and the pipe line extensions will increase the total length of the distribution system to thirty-three miles.

In the borough of Manhattan vertical shafts at suitable distances will bring the water to the surface distributing system at any point where it may be required.

The advantages of the plan, as urged upon the Commission by the city, are that it will provide means for delivering the entire Catskill supply to the five boroughs of the city, thereby unifying the city's distributing system. The pressure at which the water will be delivered will, with few exceptions, render pumping within the city limits unnecessary. After a careful study of the project and a full hearing of those opposed to the application, the Commission gave its approval. The plans for a new water supply for the City of New York, an engineering project second only to the construction of the Panama canal, have thus been brought to completion. While it is possible that minor modifications may be found necessary from time to time as the work progresses, the Commission feels that the plan, in its broad outlines, is practicable and adequate.

WATER FAMINE IN WESTCHESTER.

By section 6 of chapter 723 of the Laws of 1905 the Commission was directed to report upon the advisability of the construction of a State system of water supply. In its First Annual Report the Commission gave the results of its investigation of this subject, and while it found that the construction of a State system of water supply would be inadvisable at that time, it pointed out the fact that certain areas of the State contain groups of municipalities with a population of such density that an ultimate source of water supply outside their limits seemed inevitable. The first of these groups, in point of density of population, consisted of the counties included within the City of New York. The second was the county of Westchester. New York city has found an additional supply of water in the Catskills. chester county has hitherto depended almost entirely upon the restricted supply of water found available within its limits. This supply, however, failed during the summer of 1910, causing hardship and inconvenience and endangering the health of the community.

In accordance with a resolution adopted by the Commission early in October, 1910, providing for an investigation of the Westchester situation with a view of devising a plan of relief, the President of the Commission, with the Consulting Engineer and the Division Engineer, made an examination of conditions, which was followed by further inquiry by the Consulting Engineer. The situation is fully discussed in the Consulting Engineer's report to the Commission (p. 86). Its gravity demands the prompt adoption of remedia measures.

The investigation showed that many of the municipalities in the southern portion of the county are dependent upon New York city for an adequate supply of water when their own supply fails, the city allowing them to take a portion of the Croton supply at the high rate of \$133.33 a million gallons, which is the rate charged to consumers in the city limits. If a shortage of water in the city should be threatened, the city could not be compelled to continue this supply.

Full development of sources of supply within the county would yield additional water; but these sources would be exhausted by the rapidly growing population in 1917 or 1918. Probably they would not be sufficient to maintain an adequate supply until a new supply could be obtained from outside the county.

It has not been possible to make a detailed study of sources of supply outside the county, but it appears that approximately 35,000,000 gallons a day may be obtained at an elevation which would make pumping unnecessary and of a quality that would probably eliminate the use of filtering plants. This, with full development of local supplies, would meet the demands until 1925.

Under the present law the Westchester municipalities have a right to take water from the Catskill aqueduct upon its completion. It has been suggested that they wait until that time comes, trusting meanwhile to New York city and the more complete development of local supplies. It has also been suggested that a supply of water may be obtained from the city sources by the simple expedient of immediate annexation. Under either of those plans the water supply would cost consumers probably at least double the cost of an independent supply obtained from Popolopen creek and some of the tributaries of Peekskill creek. The present cost of pumping and filtering Westchester supplies probably exceeds \$42 per million gallons.

There has been some idea that the city might be compelled by a legislative act to supply Westchester with water at a low rate. Whether the city would consent to such a law may be doubted.

The Consulting Engineer urges that the Westchester municipalities, whose growth and development are seriously endangered by the water supply situation, take immediate and concerted action to secure temporary relief and adequate future supplies. To this end it is suggested that a metropolitan water and sewer district be created, to include that part of the county which lies south of the towns of New Castle and North Castle, and that the residents of this proposed district decide at a special election whether to form such a district and seek an independent source of supply under the direction of the State Water Supply Commission, providing the money necessary for preliminary work and submitting the final plan to the voters for approval, or to wait for the completion of the Catskill aqueduct.

The Commission earnestly commends this suggestion to the consideration of the residents of the Westchester municipalities to which it relates. If adopted, application should be made without loss of time to the Legislature for the passage of a law to give it effect.

IMPROVEMENT OF THE LAW.

While new and additional sources of water supply involving the acquisition of land cannot legally be acquired by any person, corporation or municipality without the consent of the Commission. an additional supply of water may be obtained from a source already in use or one not involving the acquisition of lands with-As a result an additional supply of water may out such consent. be obtained from a source that is unfit, as, for instance, the Niagara river, or the entire supply of a source upon which several municipalities are dependent may be absorbed by one municipality to the disadvantage of the others. This could be prevented by a change in the law requiring the consent of the Commission to any increase in water supply. Such a change would also remove any doubt as to the meaning of the present statute. The contention has been made in some instances that a municipality or company taking water from a stream or lake, or from driven wells in a defined area, may take an additional supply from any point in such a stream, lake or area without application to the Commission.

Additional water supplies have been obtained from time to time, usually by private companies, without application to the Commission. When such instances are brought to the attention of the Commission, it should have authority to require information that will enable it to determine whether a particular case is one that should be submitted for approval. There is at present no com-

pelling reason for seeking the approval of the Commission in cases which fall within its jurisdiction, unless it is proposed to condemn land or to issue bonds, which cannot be sold unless all the requirements of the law are complied with; but these reasons do not exist if land is to be obtained by private purchase and if the money to be used in the construction of the plant is not to be derived from a bond issue. In cases falling within the scope of the Commission's authority and in which the promoters neglect or refuse to submit to the procedure prescribed by the statute, the Attorney-General might be required upon the request of the Commission, accompanied by an appropriate statement of the facts, to take suitable steps to compel obedience to the law. It is obvious that unless the statute is universally and impartially enforced a portion of its beneficial effect will be lost.

In some of the smaller municipalities, owing to lack of competent advice or to other causes, difficulties have been encountered in the selection of the best available sources of water supply and in the preparation of proper plans. Occasionally appeal has been made to the Commission for its advice, either in the decision between alternate sources of supply or in regard to engineering questions, and such requests, whenever possible, have been granted.

While plans involving the acquisition of new and additional sources of water supply must be approved by the Commission before they can be executed, the authority of the Commission ceases when it has given its consent. Its jurisdiction should also extend over the period of construction, so as to insure the performance of the work in accordance with the plans filed. To this end the Commission should be empowered to call for reports upon the work, or any portion of it, at any time during its progress, to make inspections if necessary, and its formal consent should be required before any new plant is placed in operation.

Plans for the storage of water for water supply purposes must have the sanction of the Commission when a new source of supply is involved, but plans for water storage for water power purposes do not require sanction. It would seem reasonable to place in the Commission a limited jurisdiction over plans for the development of water powers. Instances have occurred in which water supplies taken from streams have been rendered unfit for use by the con-

struction of power plants and industrial establishments upon the streams above the points from which the water supplies were taken. Danger to health, litigation and needless expense might be avoided by giving the Commission authority to forbid the execution of plans for the construction of water power plants, unless it is shown (1) that they do not involve the diversion of water that is needed for water supplies, and (2) that they will not result in the pollution of water used or required for water supplies.

To guard against disaster by the breaking of dams inadequately constructed, the plans for all water storage reservoirs above a specified capacity should be submitted to the Commission for its amendment or approval.

There is a strong sentiment in certain localities in the State in favor of the regulation of the service rendered by water supply companies and municipalities and the rates charged therefor. The fact that many of these companies are owned by non-residents of this State has perhaps tended to make them indifferent to complaints of consumers. Their service has sometimes been inexcusably inadequate and their rates unsatisfactory. Such companies are peculiarly in a position to take advantage of public necessity. It has been suggested that authority to hear complaints and remedy abuses in respect to private water companies be given to the Commission and that the statute follow in general the provisions of law giving similar authority to the Public Service Commissions with respect to railway, lighting, power, telephone and telegraph companies. It seems reasonable that there should be some tribunal with power in respect to private water supply companies and municipalities to redress actual grievances.

The question of the pollution of water supplies is, in the opinion of the Commission, one of the most important of all the public questions now awaiting disposition. The inadequate provisions of law relating to the matter are a disgrace to the State. That admitted centers for the spread of so deadly a disease as typhoid fever should be allowed to continue in existence seems incredible. Reference to this subject has frequently been made in previous reports, and while jurisdiction over it properly belongs to the State Department of Health, this Commission desires again to urge the strengthening of the law. The statistics of the Depart-

ment of Health give the number of deaths from typhoid fever within the State for the ten years from 1900 to 1909, inclusive, as follows:

Year.	Number of Deaths.
1900	. 1,948
1901	. 1,741
1902	. 1,318
1903	. 1,665
1904	. 1,652
1905	. 1,554
1906	1,568
1907	•
1908	. 1,375
1909	. 1,309
	15,803

The percentage of deaths from the disease is about .10, so that the record indicates the number of cases as follows:

	Number
Year.	of Cases.
1900	19,480
1901	17,410
1902	13,180
1903	16,650
1904	16,520
1905	15,540
1906	15,680
1907	16,730
1908	13,750
1909	13,090
	158,030

The direct expense and the indirect economic loss caused by each case of typhoid fever has been placed in one of the munici-

palities of the State where the disease has been of frequent occurrence at \$500. The annual average number of cases in the State as shown by the table given has been 15,803. At the rate of \$500 for each case, this means an annual loss of \$7,901,500, or a total loss for the ten years of \$79,015,000. This makes no account of the loss resulting from deaths or of the suffering and sorrow entailed, practically all of which might be avoided by the adequate protection of water supplies.

The State, through its Department of Health, in case of an epidemic of the disease, or in case analysis discloses the presence of danger, may forbid the further use of a contaminated water This step often leaves a community entirely without water, entailing hardship and inconvenience until a new supply is obtained. The prevalence of dangerous conditions is revealed in the frequent warnings issued by local health officers to "boil the water" before using it. Although the Department of Health can abolish a water supply, it cannot, under the law as it now stands, compel the discontinuance of the source of pollution. Forcible recommendation for the removal of the defects in the statute was made in the last annual message of the Governor, and a bill to carry out this recommendation was introduced and urgently pressed for passage. It was opposed by the representatives of districts containing small municipalities, which feared that they might be put to expense by being compelled to abolish breeding places for typhoid fever germs, and also by industrial establishments desirous of retaining the privilege of polluting water courses. In consequence of this opposition, the measure failed to receive legislative approval. That conditions dangerous to life should be permitted to continue indefinitely is preposterous. Sooner or later they will be abolished. The longer suitable amendment of the law is delayed, the more drastic the action finally taken will probably be and the greater certainly will be the expense of abolishing hot-beds of infection.

While the most important step to be taken in the matter of pollution is the increase in the powers of the Department of Health, much good might be accomplished along the line of prevention by empowering the State Water Supply Commission specifically to require the adoption of measures for the future pro-

tection of the source from which a new water supply is to be taken. The law now provides that a petition for a new or additional source of water supply shall be "accompanied by such proof as to the character and purity of the water supply proposed to be acquired as the State Water Supply Commission shall require," and the Commission's rules relating to water supply applications require the applicant, in all cases, to submit chemical and bacteriological analyses of the proposed new supply. But in making a decision upon an application the law requires the Commission to determine:

First, "Whether the plans proposed are justified by public necessity."

Second, "Whether such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply."

Third, "Whether said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans."

If the Commission answers these questions in the affirmative, it seems bound to grant the application regardless of any question as to future purity of the water. It is true that the Commission may approve plans with such modifications "as it may determine to be necessary to protect the water supply and the interests of the applicant or of the inhabitants of the territory supplied by it with water, or the water supply and interests of any other municipal corporation, or other civil division of the State, or the inhabitants thereof, or the water supply and interests of any other person or water works corporation, engaged in supplying water to any other municipal corporation or other civil division of the State or the inhabitants thereof; or to bring into co-operation all municipal corporations, or other civil divisions of the State which may be affected thereby."

Therefore, to the three questions, which the Commission is now required to answer, there should be added a fourth question as follows:

"Whether such plans make adequate provision for the future protection of the source of supply from contamination."

In the absence of this authority the Commission has endeavored to ensure the purity of water supplies by insisting upon the installation of suitable purification plants; but municipal officers cannot bind their successors by any such understandings, and in one important case, at least, a promise made to install a filtration plant was disregarded with disastrous results to the health of the municipality making the application.

While, in the opinion of the Commission in the light of experience, the law may be improved in the particulars that have been indicated, it has worked successfully and has undoubtedly been of great benefit to the people of the State. It has protected the various civil divisions from unwarrantable encroachment upon their water supplies, ensured adequate compensation for damages, made it possible for differences of opinion to be presented for impartial decision, facilitated the construction of water supply plants and largely prevented serious errors in plans.

The prolonged drought of last year placed a severe strain on uncertain sources of water supply and in many localities caused much inconvenience. Some idea of the nature of the questions relating to water supplies that were submitted to the Commission for its decision during the year will be found in Appendix A, which contains a statement of the applications made and the decisions thereon.

RECOMMENDATIONS.

The Commission makes the following recommendations in respect to water supplies:

- (1) That plans for obtaining additional water supplies, as well as additional sources of supply involving the acquisition of land should require approval.
- (2) That more effective means be provided for compelling the submission of plans.
- (3) That the jurisdiction of the Commission be extended so as to cover constructive work after plans have been approved and its consent be required before a new plant is used.
- (4) That water storage plans for power purposes be required to be submitted for approval so far as the protection of water supply needs and the public safety may require.

- (5) That authority to regulate the service rendered and the rates charged by water companies and municipalities be given to the Commission.
- (6) That the Commission be required to decide whether water supply plans make adequate provision for the future protection of the source of supply from contamination.
- (7) That the acquisition of private water companies by other private water companies, or by municipalities, or the consolidation of private water companies without the consent of the Commission be prohibited.
- (8) That the consent of the Commission be required for the acquisition of sources of water supply in cases where the supply is to be used wholly or partly in another State.

The use of water for water supply purposes is its highest use and to this all other uses must give way.

II. RIVER IMPROVEMENT.

The work accomplished during the year under that portion of the law giving the Commission authority over river improvements has been important. The improvement of the channel of Canaseraga creek has been begun, the preliminary steps for hearings upon the request for the improvement of the Genesee river have been taken, thus bringing it to the stage where hearings may be given, and surveys are being made for the improvement of the Hudson river upon petitions filed. None of the localities, which have been accustomed to apply to the Legislature for special appropriations for the improvement of unruly streams, have made application to the Commission, although notices were sent by the Commission calling their attention to the opportunity offered by the law for making the needed improvements under the direction of the Commission at the expense of the locality.

The absence of a satisfactory general law providing for water storage for power purposes has led to attempts on the part of those desiring river regulation for the improvement of water powers to attain their object under the sections of the present law which relate to river improvement. While the law in its amended form is sufficiently comprehensive to make possible river improvement for the protection of the public health and safety, it does not on its face contemplate the construction of storage reservoirs for water power purposes. The efforts to make use of a law that was drawn specifically for one purpose in order to accomplish another purpose, in the opinion of the Commission, can lead only to confusion, misunderstanding and ultimate disappointment.

The law providing for river improvement was passed before the State Water Supply Commission was created. Chapter 734 of the Laws of 1904 provided that a Commission consisting of the State Engineer and Surveyor, the Attorney-General, the Superintendent of Public Works, the Forest, Fish and Game Commissioner and one Commissioner who should be a civil engineer appointed by the Governor, should constitute the River Improvement Commission. It was found that the plan of creating a Commission consisting of State officers, whose attention was already fully occupied with the duties of their several departments, was not satisfactory, and by chapter 723 of the Laws of 1905 the River Improvement Commission was abolished and its powers and duties devolved upon the State Water Supply Commission. Improvement Law, when the State Water Supply Commission endeavored to apply it, was found to be so defective in several particulars that it was unworkable. The tests made during the proceedings for the improvement of Canaseraga creek revealed the weak places and successive amendments have produced a workable statute when river improvement for the protection of the public health and safety is the object which is sought to be reached. CASSES SALA

CANASERAGA CREEK.

At the date of the last report the proceedings in the Canaseraga creek improvement were well advanced. Subsequent hearings were held at the court house in Geneseo, February 9, at the village hall in Mount Morris, March 2, 29, April 8 and April 15, on which date the hearings with reference to fixing the bound-

ary lines of the improvement district, were closed. On April 15 the Commission's final determination with reference to the fixing of the boundary lines of the improvement district was rendered and the original plans were declared to be the final plans.

The Commission advertised the sale of bonds in the sum of \$200,000, bids were received by the State Comptroller and opened on July 1, and the bonds were sold to the Windsor Trust Company of New York city at 103.13 and accrued interest. The bonds were issued in registered form in denominations of \$5,000 and were delivered to the purchaser on September 8, 1910, and the amount, \$208,093.33, was deposited in the National Commercial Bank in Albany to the credit of the Canaseraga creek improvement fund. A detailed statement of the disbursements from this fund will be found in Appendix E.

On May 7, 1910, a petition for writ of certiorari was served by Charles W. Bingham, trustee, and others, the relator asking that no tax be levied for the improvement upon his lands, alleging that the proceedings of the Commission were unlawful and the plan of improvement illegal and also that his lands would not be benefited. The case was argued before Justice Sutherland in June. As it seemed impossible that any decision, even if adverse, could go further than the exclusion of the lands of the relator from the assessment district as defined by the Commission, the bonds were sold in July and a contract was let in September providing for the completion of the work on or before September 12, 1912. The contractor sublet portions of the contract and began construction work. At the date of this report no decision had been made.*

GENESEE RIVER.

The Commission has proceeded in accordance with the statute, with the preparation of preliminary plans, specifications, estimates, lists and statements required by law to be filed in the county clerk's offices in the several counties benefited by the proposed improvement of the Genesee river. These plans and other documents

[&]quot;In January, 1911, Justice Sutherland rendered a decision holding the proceedings for the improvement of Canaseraga creek to be illegal on the ground that the plan involved the drainage of swamp land. He did not decide whether the lands of the relator were properly included in the assessment district. An appeal has been taken from this decision.

were filed in the offices of the clerks of Monroe, Livingston and Wyoming counties on the fifteenth and sixteenth days of December, 1910. The Commission set the date of February 2, 1911, for the first public hearing pursuant to the statute in connection with this petition.

The State has shown much interest in the preparation of plans for the improvement of the Genesee river. The matter was brought forward more than twenty years ago when the State Engineer made a survey and in 1890 proposed the construction of a dam at Mount Morris. The Legislature in 1893 and 1896 appropriated \$20,000 for further surveys which resulted in the proposal to build the Portage storage reservoir. A bill was introduced in the Legislature in 1895 "providing for the construction of a dam on the Genesee river for purposes of the Erie canal, and for restoring to the owners of water power on the Genesee river the water diverted by the State for canal purposes," as follows:

"Section 1. For the purpose of improving the supply of water to the Erie Canal, and of restoring to the owners of water power on the Genesee river, the water diverted by the State for canal purposes, the superintendent of public works is hereby authorized and directed to construct, or cause to be constructed a dam on the Genesee river on one of the sites designated in the report of the state engineer and surveyor to the legislature, dated December ————, eighteen hundred and ninety-three. Said dam shall be constructed one hundred and thirty feet in height above the present flow line of the river, according to plans and specifications which the state engineer and surveyor is hereby directed to prepare and furnish, and in which he shall define its precise location.

"§ 2. The sum of two hundred thousand dollars, or so much thereof as may be necessary, is hereby appropriated from any moneys in the treasury not otherwise appropriated, to be paid on the warrant of the comptroller to the state superintendent of public works for the purpose of constructing said dam as provided in this act."

This bill failed to become a law.

The River Improvement Commission made studies of the river and when the Water Supply Commission succeeded it, the application of Monroe county, under which proceedings to determine whether the plan of improvement shall be carried out have now been begun, was made and the machinery provided by the River Improvement act was set in motion. The Legislature in 1908 again indicated its interest in the project by advancing \$25,000 for making the surveys, provided the project was declared to be of sufficient importance to warrant the interference of the State, and a further sum has been spent out of the various appropriations made to enable the Commission to prosecute surveys throughout the State of possible water power developments, among which the Genesee was necessarily included.

While the petition of the county of Monroe is based, in accordance with the statute, upon the allegation that the protection of the public health and safety requires the regulation of the flow of the river, it is evident that the main object sought is water storage for power purposes. This clearly appears from the arguments advanced during the hearings that have been given upon the petition, although much emphasis has been laid upon the incidental benefits to be derived from the project. It is to be noted in this connection that one of the arguments most strongly insisted upon during the hearings,— the relief of the city of Rochester through an increase of the flow of the river sufficient to dilute and carry off the sewage poured into the river within the city limits,— has been almost if not entirely destroyed by the plans which have been adopted by the city for the construction of a sewage disposal plant, if such plans are executed.

In its last annual report, in discussing the Genesee improvement, the Commission said:

"It (the Commission) does not believe, however, that this project should be carried out under the River Improvement law, involving as it does the development of power as the principal object."

The complications that may arise from the construction of a storage reservoir for the protection of the public health and safety, that is, for the abatement of floods, and its operation for water power purposes are well exemplified in the Genesee project. If the reservoir is to be operated for the prevention of floods, the water accumulated by any excess of flow should be released as soon as possible with safety so that the reservoir may be in a condition to receive and hold back the next flood that may come. If it is to be operated for the purpose of producing the greatest possible amount of power, the accumulation of water should be released gradually, with the object of supplementing the flow of the stream so that it may be sustained at a certain minimum. Unless this is done and the industries dependent upon water power can be assured of a satisfactory minimum flow, a storage reservoir is largely useless for power purposes.

Furthermore, it would be unjust to assess the cost of constructing a reservoir built for the storage of water for power purposes upon property which has no interest in the development of water power but is seeking merely protection from floods. It would be equally unjust to assess the owners of water power rights not suffering from floods for the cost of a reservoir built solely for flood control.

An effort has been made to escape from this dilemma in planning the Genesee improvement by providing for a reservoir with sufficient capacity to impound flood waters and at the same time to store a sufficient amount of water to equalize the flow of the river for the production of water power. This has been done so that the considerable sums required to complete surveys and the preparation of plans might not be wasted so far as water power conservation is concerned.

In dealing with the Genesee river and with other similar situations involving the storage of water for power purposes the Commission, acting under the restrictions of an inadequate statute, has endeavored, so far as it has had authority, to guard the interests of the State and minimize the expenditures for surveys and the preparation of plans. It must adhere, however, in the exercise of its authority to the limitations imposed by the statute.

In order that the situation upon the Genesee river may be understood, now that proceedings have actually been begun for its improvement, it is necessary briefly to describe the interests involved. The two companies most conspicuously mentioned in connection with water power rights are the Genesee River Company and the Rochester Railway and Light Company.

The powers conferred by the State upon the Genesee River Company are contained chiefly in section 6 of chapter 605 of the Laws of 1898 which reads as follows:

"Said corporation is hereby authorized to construct a main dam or reservoir on the Genesee river for the purpose of improving the sanitary condition of the Genesec valley, of checking floods in the Genesee river by producing as far as practicable an equable flow therein, of supplying necessary water to the enlarged Erie canal, and of furnishing pure and wholesome water for municipal purposes. The said corporation shall construct and maintain said main reservoir or dam on the Genesee river at the site thereof near the village of Portageville, which is described in appendix seven to the annual report of the state engineer and surveyor for the fiscal year ending September thirtieth, eighteen hundred and ninetysix; and the said main dam or reservoir shall be constructed of masonry with the crest of its spillway at an elevation of one hundred and eighteen feet above the present ordinary water surface of the Genesee river at the site aforesaid. Said corporation shall have the right to utilize all the water power incidentally created by the construction of said main dam or reservoir, and for the purpose of such utilization said corporation may construct, maintain and operate in and upon the Genesee river and its tributaries within one mile of the mouth of each of such tributaries and along the line thereof, at any and all points below the location of the aforesaid main dam or reservoir, all necessary power dams, subsidiary reservoirs, sluices, gates, trunks, irrigation canals and distributaries, hydraulic power, raceways and all other necessary appliances for the purpose of utilizing the water and water power of the said river for the development of hydraulic and. electrical power and for the purpose of making and transmitting compressed air and for other purposes. Said corporation shall have the right to construct, maintain and operate said power dams and subsidiary reservoirs and appliances upon the necessary lands upon acquiring by purchase title thereto or the right of way or other easements or interests in the same from the owners thereof, and the said cor-

poration may acquire by purchase the title to or other interest in and become the owner of any and all lands along the line of the said Genesee river or its tributaries within one mile of the mouth of each of such tributaries below the said main dam or reservoir which may become necessary or which shall be deemed advantageous or proper to said corporation for the purposes in this act mentioned. It shall also have the right to purchase, hold, lease, sell and convey lands, water rights or other property for the purposes of its business, and upon said lands to accumulate, store and conduct water from the said Genesee river and its tributaries within one mile of the mouth of each of such tributaries and to sell, lease, furnish, operate and supply the said water by conducting the same in such manner as may be most convenient, feasible or economical, and to sell, lease, furnish and dispose of the power developed or to be developed from the flow or storage of the said water for fire, light, sanitary, municipal, manufacturing, agricultural, power or other purposes, and shall also have the right, by such hydraulic, electrical, compressed air conductors or other devices as shall be permitted by the local authorities of any city, village or town of the state in or through which such conductors or other devices shall be constructed, operated and maintained, to conduct, convey and furnish such power to, through or in any village, town or city within the counties of Monroe, Orleans, Genesee, Wayne, Ontario, Livingston, Wyoming and Allegany, or any of them, and to acquire, operate and maintain all such machinery and other apparatus as shall be necessary or proper for the transmission of such power to or within the said counties or any of them. The said corporation shall also have the right, upon obtaining the consent therefor of the local authorities, to furnish pure and wholesome water to any village, city or town in any of said counties of Livingston, Wyoming and Monroe, upon such terms as may be agreed upon between the local authorities of such village, city or town and the board of directors. Said corporation shall also have power to erect upon lands owned by it, buildings for the purpose of dwellings, manufacturing or business purposes, and to sell or lease the same.

It is the general intent and purpose of this section to grant unto said corporation power to maintain, construct and operate said main dam or reservoir upon the Genesee river near Portageville with said subsidiary reservoirs and power dams upon the Genesee river and any of its tributaries within one mile of the mouth of each of such tributaries below the site of the said main dam or reservoir, and to use the water of the said Genesee river and its tributaries for the generation of hydraulic and electrical power and for compressed air, together with the right to construct maintain and operate machinery, transmission lines and other apparatus for the purpose of generating and transmitting power by water, electricity or compressed air for power or other purposes, and to sell, lease and dispose of the said hydraulic and electrical power and compressed air so generated. But nothing contained in this act shall be construed as affecting or authorizing the taking or impairing of any private or municipal right in the natural flow of the Genesee river at any point below the said main dam or reservoir, or on any tributary below said main dam or reservoir, or any real or other property or interest therein below said dam or reservoir, except by agreement with or by consent of the owners of such rights, property or interests so affected, taken or impaired respectively."

The company was incorporated by the Legislature on April 29, 1898. Its capital stock was \$3,000,000 and it was required to expend within five years 10 per cent. of its capital in construction, failing which, the law provided that "the said corporation shall be dissolved." The company did not meet the requirement of the Legislature as to expenditure and it did nothing to improve the river. In 1906, three years after the expiration of the limit of time within which the law required construction to be begun, the Legislature passed a bill extending this limit for another five years, or until July 1, 1911.

It is obvious that if the charter of the company should be deemed to be still effective, it would derive great benefits from the construction of the proposed storage reservoir and, therefore, should be assessed for a correspondingly large portion of the cost of construction. It is equally obvious that, if the charter is dead, the levy of such an assessment would be inappropriate and might lead to injurious delays in the execution of the work.

There are in Rochester thirty-three water power plants on the Genesee river with an installation of 26,000 horse power. These plants have steam auxiliary of 21,800 horse power valued at \$1,250,000 and using coal at an annual expense of \$150,000 to \$200,000 in addition to an annual maintenance charge of \$100,000.

An examination of the situation shows that the Rochester Railway and Light Company owns or controls far greater operating water power rights in the river than any other interest. Rochester this company has a practical monopoly of the water power generated at the Middle and Lower Falls. At and above the Upper Falls there are three power races: The Johnson and Seymour race, Brown's race and the Carroll and Fitzhugh race. In each of these powers the interest of the Rochester Railway and Light Company is predominant. The company also owns water power sites on the river at York, Geneseo and above Mount Morris. The development at Mount Morris is controlled by the Genesec River Company, partly as owner and partly as lessee of other shares. These interests and the owners of the thirty thousand acres of farming land in the valley below Letchworth park will be immediate and direct beneficiaries of the storage project. In addition, important benefits will be conferred upon the community in general by the improvement of sanitary conditions and the prevention of dangerous and damaging floods, the destructive power of which has been manifested at frequent intervals, especially in the city of Rochester.

Fear has been expressed that the construction of the Portage dam may detract from the beauties of Letchworth park, the magnificent gift made to the State in 1907 by Mr. William Pryor Letchworth. Any bill passed by the Legislature to authorize the building of the dam should contain specific provision for maintaining the flow of the river through the park at a volume well above the present minimum flow during the daylight hours and well into the evening, that is to say, at all times when the park is likely to contain visitors. Such a provision, with the creation of a well-kept navigable lake fifteen miles long adjoining the park and under

State control, would enhance rather than decrease its attractiveness.

The estimated cost of the improvement is \$4,588,000, and the annual maintenance charge, including the interest and sinking fund payments, is \$295,000, the improvement bonds running for a period of fifty years with interest at 5 per cent. In accordance with the requirement of the statute under which the petitioners are proceeding, the Commission has apportioned the cost as follows:

Counties	.5	per	cent.
Towns	1.5	per	cent.
Cities	5.0	per	cent.
Villages	.2	per	cent.
Individual owners of property	92.8	per	cent.

It is not by reason of the ownership or non-ownership of specific rights or of water power sites by the State that it is called upon to act in the matter of water power development. It is the exercise of a governmental function inherent in all the people of the State to do that which individuals cannot do. The value of the exercise of this authority, the power owners who urge action under the River Improvement Act and who suffer by reason of the irregular flow of power streams, say should come to them without their being compelled to contribute anything beyond the actual amount expended by the State, even though the benefits derived therefrom amount to several thousand dollars per year. The Commission has taken the position that the owners of property benefited should pay to the State the value of such benefits. Such is the clear meaning of the Fuller Act under which the Commission made its studies to determine the value of the water powers of the State.

The work on the Genesee has been done by the Commission under the River Improvement Act pursuant to petitions as provided therein. The constitutionality of this act is based upon the fact that the Commission is directed to say, before any work begins, that the danger to public health and safety is of sufficient importance to demand interference by the State.

The law directs the Commission "to prepare a statement or list of the counties, towns, cities, villages and individual properties which in its judgment will be benefited by reason of such improve-

ments, together with a statement of the proportional share of said total cost which should be borne by said counties, towns, cities and villages respectively, and by the individual owners of the property benefited collectively expressed in decimals." This law also provides for a public hearing after which the Commission shall determine whether the statements, maps, plans, etc., should be modi-The Commission has made the tentative maps, plans, specifications, estimates and statements and fixed a day for a public hearing thereon. Upon this hearing it is expected that the rights of the several individuals, corporations, franchises and municipalities, and what portion of the expense such property and rights should pay toward the total cost of the storage dam on the Genesee will be discussed. After such hearing the Commission will determine whether the proposed improvement on the Genesee river shall be abandoned or proceeded with and what, if any, modification should be made in such plans, specifications, estimates and statements, and if it is determined that the improvement shall go forward, fix the portion of the total cost of such improvement the property and municipalities benefited should pay.

Since the improvement is entirely local in its nature, no part of the cost has been apportioned to the State. Upon the completion of the reservoir, however, the water power at the dam, owing to the location of Letchworth park, may be developed by the State and by the State alone, assuming that any dormant grants that may have been made have been repealed. The Commission in accordance with the Fuller Act, has prepared plans for the development of this water power by means of a tunnel. The cost of this work is estimated as follows:

Tunnel and power house	\$2,282,000
Annual operating, interest and sinking fund charge	100,000
Annual gross revenue	300,000

These figures are based upon the sale of water power at the power house. If the State should go a step further and convert this power into electricity at an added cost of \$1,065,000, its gross annual income therefrom would be not less than \$700,000. This method of development, of course, would bring all the electrical

power developments in the western part of the State into competition with the State.

Whatever may be the possibilities, however, there is no method under the law as it now stands permitting the State to take advantage of its opportunity at Portage, and, therefore, the Commission has felt that it would not be justified in apportioning to the State any part of the cost of the work.

HUDSON RIVER.

Petitions for the improvements of the Hudson river were filed with the River Improvement Commission in February and March of 1905. Subsequent to the investigations made under the Fuller Act, and on December 17, 1909, the following petitions for the regulation of the flow of the river for the protection of the public health and safety were received by the Commission and placed on file:

- 1. Petition of the city of Albany.
- 2. Petition of the town of Queensbury, county of Warren.
- 3. Petition of the employees of the West Virginia Pulp and Paper Company of Mechanicville, Saratoga county.
- 4. Petition of the residents and business men of the village of Mechanicville, Saratoga county.
- 5. Petition of the International Paper Company, Union Bag and Paper Company, Iroquois Pulp and Paper Company, West Virginia Pulp and Paper Company, Hudson River Power Company, Hudson Valley Railway Company and Finch-Pruyn Company.

Under the provisions of the Fuller Act, the Commission has continued its investigation of last year by making a complete power survey of the Hudson river from Troy to Hadley. This survey has included an accurate profile of the river and a detailed examination into the conditions affecting the development of water power at each of the numerous plants along the river.

The petitions for the improvement of the Hudson are intended to bring about the construction of the Sacandaga reservoir. This appears from a statement made by the attorney for several of the petitioners at an informal hearing on November 17, 1910, as follows:

"So far as this petition is concerned, it refers to the so-called Sacandaga storage project and it is known the State over through the reports of this Commission and through published papers, and especially through a detailed reference to it in the message of the Governor last year, that the Sacandaga project presents a storage proposition of great public importance and an ideal one from the standpoint of hydraulic development."

The complete control of the Hudson river would involve the construction of a large number of reservoirs at its headwaters and upon its tributaries. Some of these reservoirs would occupy State land within the boundaries of the Adirondack park, and, therefore, cannot be built until the Constitution has been amended so as to permit the use of State land for this purpose. The surveys and plans which have been made by the Commission in this watershed under the Fuller Act during the last three years were made as the law directed for the purpose of obtaining information regarding the development of water power by the State and not for the purpose of devising means for flood prevention. Consequently, although the studies that have been made are useful so far as they go, they do not constitute a complete scheme of flood prevention.

The petitions now before the Commission, while in form they ask for complete flood prevention, in fact ask for flood prevention so far as it can be accomplished by the construction of a reservoir on the Sacandaga river. The measurements made indicate that the reservoir would mitigate the severity of the spring floods and that it would moderate decidedly the floods occurring at other seasons. It would be far from a complete prevention, but it is entitled to consideration on its merits as a partial measure for the protection of public health and safety. Surveys have shown that complete theoretical control of the flow of the Hudson would require water storage in a succession of reservoirs to the total amount of 120,000,000,000,000 cubic feet, of which only 60,000,000 cubic feet is practicable. While the proposed reservoir on the

Sacandaga river would have a capacity of only 29,000,000,000 cubic feet, nevertheless it is the largest single reservoir that can be built for Hudson storage. By increasing the flow of the Hudson in the dry season it would aid navigation.

The estimated cost of the Sacandaga reservoir was given in the Commission's last report as follows:

Construction					\$4 ,650,000	
Annual	maintenance,	interest,	sinking	fund	and	
other	charges		• • • • • • •	• • • • •		237,700

As the annual interest and sinking fund payments of \$180,700 were based upon an interest rate of 3 per cent. for fifty-year bonds, it is probable that the total would be increased to some extent by the necessity of paying a higher rate.

Although the plans for the Sacandaga reservoir are practically complete, it will be necessary, before hearings can be given, to prepare a statement of the counties, towns, cities, villages and individual property owners which, in the opinion of the Commission, will be benefited thereby, and to make an apportionment to them of their proportional shares of the total cost of the work.

The State would derive no direct return from the Sacandaga reservoir under the present law. As in the case of the Genesee reservoir at Portage, the plans for the Sacandaga reservoir render possible an important water power development at the dam which would be owned and controlled by the State. By the construction of a rock tunnel two miles long the use of the water from the reservoir would yield 25,000 to 30,000 continuous horse power. It has been roughly estimated, as shown in the report of Mr. John R. Freeman, included in the Commission's report of 1908, that this development could be made and a power house and transmission lines built for \$5,000,000, with annual charges amounting to \$428,000. The sale of 25,000 horse power in the form of electrical energy at the rate of \$25 per horse power per year would yield a present income of \$625,000 and more in the future.

The dangerous and unsanitary conditions caused by Hudson river floods below the State dam at Troy are almost wholly due

to ice jams in the river channel. Floods from this cause cannot be wholly prevented by any system of water storage. The execution of the plans of the federal government for improving the river channel between Troy and Coxsackie will doubtless improve conditions, and it is expected that good results will follow the action taken by the last Legislature in authorizing the Superintendent of Public Works to use tug boats to break up the ice jams.

OTHER PETITIONS.

When the duties of the River Improvement Commission were transferred to the State Water Supply Commission, there were several river improvement petitions pending before the River Improvement Commission. The petitions made to that Commission, which have not been moved before the State Water Supply Commission, and the disposition of each were as follows:

CHENANGO RIVER.

The petition of P. F. McGrath and fifteen other riparian owners for relief from flood conditions, which they stated were a menace to the public health and safety in Binghamton, was filed with the River Improvement Commission on January 24, 1905. It was referred to the Engineer Commissioner, who reported on March 30, 1905, that storage of the flood waters would apparently be too expensive, and he recommended the construction of a dike and some appurtenant structures as the most practicable plan for flood relief in Binghamton. Individuals having offerred to bear the major portion of the expense of making the surveys and plans, the Engineer Commissioner was authorized to prepare preliminary maps, plans and estimates, pursuant to the statute, at no expense to the State except his own salary and personal expenses. Plans were prepared and were adopted by the River Improvement Commission on January 10, 1906, on which date the River Improvement Commission also rendered its determination as to the apportionment of the assessments, deciding that the city of Binghamton, as such, should bear the entire expense of the proposed improvement. The preliminary maps, plans, etc., were subsequently filed in the county clerk's office in Broome county, and a public hearing was held on February 28, 1906, at the effice of the Attorney-General in Albany. The River Improvement Commission then issued a final order for the execution of the improvement and transmitted it to the Legislature, which took no action.

WOODBURY CREEK.

The petition of various riparian owners of Woodbury creek, town of Woodbury, county of Nassau, was filed with the River Improvement Commission July 26, 1905. The Engineer Commissioner was directed to make a preliminary investigation, and he reported October 25, 1905, recommending the construction of a rock cutoff as the most practicable means of relieving the flood con li-The Engineer Commissioner was accordingly directed to prepare the maps, plans and estimates required by statute, and on January 24, 1906, these maps and plans were adopted by the Commission; and the Commission's determination as to the apportionment of cost was also rendered, specifying that two-thirds of the cost should be borne by the town of Woodbury and one-third by the individual property owners benefited collectively. A public hearing was held at the office of the Attorney-General in Albany, March 7, 1906, after which the River Improvement Commission denied the petition on the ground that the conditions did not constitute a sufficient menace to the public health and safety to warrant the Commission in proceeding.

RAQUETTE RIVER.

At a meeting of the River Improvement Commission held on May 25, 1905, a petition was received from certain riparian owners on the Raquette river praying for relief from conditions said to constitute a menace to the public health and safety. The petition was referred to the Engineer Commissioner, who reported on July 26, 1905, calling attention to what he considered very favorable opportunities for the construction of storage reservoirs to accomplish the results desired by the petitioners. On that date the Engineer Commissioner was authorized to make suitable preliminary surveys and plans at no expense to the State except for the Engineer Commissioner's salary and personal expenses. He reported further on February 6, 1906, recommending the construction of four reservoirs, as follows:

- 1. With dam at the Oxbow, above Tupper lake. (Flooding of State lands involved.)
- 2. Dam at outlet of Round lake, flooding Round lake and Little Tupper lake. (No State lands involved.)
- 3. With dam at Moosehead, Stillwater. (No State lands involved.)
 - 4. Holleywood, Stillwater. (No State lands involved.)

The petitioner having offered to pay the expense of the preparation of preliminary maps and plans, the Engineer Commissioner was directed on July 26, 1905, to prepare them. This work was in progress when the duties of the River Improvement Commission were transferred to the State Water Supply Commission and very soon thereafter the Engineer Commissioner died without having reported on the project.

SILVER CREEK.

The petition of the president of the village of Silver Creek, Chautauqua county, and various riparian owners on that creek was filed with the River Improvement Commission on February 23, 1905. On March 1, 1905, the Engineer Commissioner was directed to make preliminary investigations and report. He reported on March 30, 1905. The improvement was not further progressed owing to failure of the Legislature to make appropriation for the necessary surveys and investigations.

SARANAC RIVER.

The petitions of the towns of St. Armand, Franklin and Black Brook and certain riparian owners on Saranac river praying for relief from conditions which were said to be a menace to the public health and safety, arising from the irregularities of the flow of the Saranac river, were filed with the River Improvement Commission on September 28, 1905. The Commission held several public hearings, at which the petitions were opposed on the ground that the execution of the proposed improvements would result in flooding State land in the forest preserve in violation of the Constitution. Proceedings on this proposed improvement were, therefore, abandoned.

PAPER MILL BROOK.

A petition from certain riparian owners on Paper Mill brook, town of New Berlin, Chenango county, was filed with the River Improvement Commission on December 7, 1905. The matter was referred to the Engineer Commissioner, who reported January 24, 1906, that there was a condition of overflow. No further proceedings were taken.

RIVER IMPROVEMENT AT LOCAL EXPENSE.

Chapter 284 of the Laws of 1909 gave the Commission jurisdiction over the improvement of water courses at local expense. Under the provisions of this act the village of Tupper Lake filed a petition on July 19, 1909, for the construction of a low dam on the Raquette river at Setting Pole Rapids. The project was described in the Commission's last annual report. There have been no further developments during the year, the petitioners having so far failed to deposit the funds required by the statute for the execution of the work.

LOCAL LOSSES FROM FLOODS.

It has been the custom of communities suffering losses from floods to cause special appropriation bills for their relief to be introduced in the Legislature. A number of such bills were passed by the last Legislature and disapproved by the Governor on the ground that the river improvement statutes were intended to provide for such cases and that if the State was to take them up, petition should be made to the Water Supply Commission pursuant to the provisions of the statute.

The Commission, after the adjournment of the Legislature, communicated with the local officers or the legislative representatives of the communities on behalf of which bills had been introduced asking for appropriations, as follows:

 provement of various streams were passed by the last legislature and vetoed by the Governor, who in explanation of his disapproval said:

"It does not satisfactorily appear that there is any obligation on the part of the State to make these improvements. If either of the cases fall within the river improvement act, proceeding may be taken under its provisions.

"The river improvement act to which the Governor referred was included in the Consolidated Laws and constitutes a portion of Article 2 of the State Boards and Commissions law, which defines the powers and duties of the State Water Supply Commission. The article referred to is reproduced in Appendix 'C' of the Fifth Annual Report of the Commission, a copy of which is being sent to you under separate cover. This report also contains the information necessary for the preparation of a petition for river improvement.

"The Commission has thought it proper to advise you that it is ready at any time to consider a petition in accordance with the provisions of the statute for a proceeding to bring about the improvement desired by your community and to determine what portion, if any, of the expense may properly be borne by the State.

"The Commission will be glad to furnish any additional information that may be required."

Only one reply was received, namely from the commissioner of public works of the city of Utica, who stated that the improvement contemplated was not considered of sufficient importance to the city of Utica to warrant its officials filing a petition.

AMENDMENT OF THE LAW.

During the progress of proceedings last summer for the improvement of Canaseraga creek it was found that a portion of an amendment of the River Improvement Law made by chapter 354 of the Laws of 1907, had been omitted in the consolidation of the law in 1909. This amendment affected section 12 of the State Boards and Commissions Law. The secretary of the Board of

Statutory Consolidation informed the Commission that the board had intended to include the omitted portion of the section and that his examination of the records of the board led him to believe that the omission was due to an error of the printer. The omitted amendment, which should have been added at the end of section 12 of chapter 56 of the Laws of 1909, which relates to proceedings upon approval of a petition for river improvement, reads as follows:

"The Commission shall have power to make such minor changes in the said final map, plans and order as the nature of work may require, provided that such changes shall not add to exceed ten per centum to the cost of executing the plans embraced in such final order as approved by such act of the legislature; and provided, further, that if any such minor changes shall add more than ten per centum to the cost of any such improvement, a final order for which has been approved by an act of the legislature, the commission shall publish such fact, and shall give a hearing thereon as in the first instance with special reference to such increased cost of improvement, and shall await thereafter a further and final approval by subsequent act of the legislature."

In the judgment of the Commission the inclusion of this amendment is important to the effective accomplishment of river improvement work and the Commission recommends that it be restored to the law in its proper place.

The Commission, therefore, recommends in relation to river improvement:

- (1) That the law be amended by restoring the portion inadvertently omitted during the consolidation.
- (2) That where water power development is, in the judgment of the Commission, the principal object of an application for river improvement, authority be given to the Commission to reject the application for that reason.

III.

WATER STORAGE AND THE CONSERVATION OF WATER POWER RESOURCES.

Surveys and investigations resulting in the accumulation of data of great value to the conservation and development of the water power resources of the State have been made during the year under the direction of the Commission by its engineering staff. This work has been directed mainly toward the completion of plans for water storage upon rivers where important industries already established have suffered heavy losses from the failure of power due to preventable fluctuations of stream flow. It has carried forward the studies of the following rivers:

The Black river and its tributaries, upon which the 78,890 intermittent water horse power now in use is capable of being greatly increased;

The Oswego-Seneca river and its tributaries, including the Finger lakes, where the 34,345 intermittent water horse power now used is capable of being largely augmented;

The Hudson river, from Troy to Hadley, with 135,447 intermittent horse power in use;

The Genesee river, with 18,063 intermittent horse power in use. In addition, the work of stream gaging has been continued and extended in co-operation with the United States Geological Survey, the rainfall observations have been extended and maintained and studies of evaporation have been made. This material will be extremely useful in connection with water power development plans, whether public or private.

The detailed results of these studies are described and discussed in the report of Walter McCulloh, Consulting Engineer.

A new branch of work was undertaken in the investigation of small water powers for farm and country home use. The results of this investigation are set forth in the report of David R. Cooper, Engineer-Secretary, submitted herewith.

POLICY OF THE STATE.

The policy of the State with regard to the conservation and development of its water powers has been of gradual growth, al-

though each step has led in the same general direction. An account of various investigations made will be found in the report of the Consulting Engineer for the year 1908.

Following an agitation of more than ten years, during which the increasing importance of the water powers of the State constantly obtained greater recognition, the Legislature in 1902 created the Water Storage Commission, consisting of five citizens appointed by the Governor to act with the Attorney-General, the State Engineer and Surveyor, the Superintendent of Public Works and the Forest, Fish and Game Commissioner, to investigate the causes of floods and to make recommendations for their prevention. This Commission found that the loss from floods in the State during 1902 had exceeded \$3,000,000. Its studies of the various streams led it to call attention forcibly to the extremely valuable possibilties of water power development, and in the report which it made to the Legislature in 1903 it said:

"We believe that state supervision and control is the only safe method of intelligently initiating, constructing and maintaining an adequate system of river improvement in this state. Such state supervision and control, by a commission of recognized competence and character, would not only secure the scientific treatment of such stream as a whole, but the safe and economical execution of the various component parts of a comprehensive system of river improvement in the order of their relative urgency and importance. Legislation providing for such a system of river regulation is in our opinion a great and urgent public necessity."

The Commission further recommended that the work of river improvement should be entrusted to a permanent commission and that its cost should be borne entirely by the property benefited.

This recommendation was adopted by the Legislature, which thereby committed the State to the policy of State control. In 1907 the Legislature took a further step by establishing the principle that new grants of water power rights should be made only upon the basis of an annual payment to the State for the privilege granted, the amount of such payments to be readjusted at specified terms. Upon these conditions authority was granted to a

corporation to use water power in the St. Lawrence river for the operation of an electrical power plant on the Long Sault rapids.

Still another and more important step was taken by the Legislature of 1907 by the passage of the law commonly known as the "Fuller Act" (Chapter 569 of the Laws of 1907). directed the State Water Supply Commission to collect information relating to the water powers of the State, devise a general plan for their progressive development and to report a draft of a referendum bill for a general law to carry its recommendations into In the preparation of its plans, the Commission was directed, in case the construction of a dam upon any water course was included, to "estimate the water horse power which would be developed at such proposed dam, the probability of selling such water power, and the probable gross and net revenues from both direct and indirect sources which would be derived from the sale of such power at such proposed dam." In the preparation of the bill which the Commission was directed to draft in order to carry out its recommendations, it was required to include a financial plan providing for the issue of State bonds to pay the cost of water power development and for an annual tax sufficient to pay the interest and sinking fund charges thereon. The bill also provided that "the rate of charge for the use of the water horse power under contract for sale shall be based upon the aggregate cost of the development * * * and such rate of charge shall be so adjusted that it will produce a net revenue sufficient to pay, in addition to all costs of superintendence, maintenance and depreciation, the interest upon the bonds as the same shall become due and the principal of said bonds at their maturity."

Thus at the beginning of 1908 the Legislature had outlined a State policy with regard to water powers, the principal points of which included State control, the payment of compensation for new grants, the storage of water by the State at public expense and the sale or lease of the right to use the water so stored upon terms which would reimburse the State for its outlay, and the progressive development by this method of all streams capable of yielding additional water power.

In pursuance of the policy outlined in the Fuller Act, the State has expended upward of \$100,000 in ascertaining the extent and value of its undeveloped water power resources and in making the detailed surveys and estimates required by the act.

In recommending the subject to the last Legislature, the Governor in his annual message expressed the opinion that the following principles should be accepted:

- "(1) That the flow of water in our rivers should be regulated and our water powers developed to the fullest extent that may be practicable. This is essential to prevent unnecessary damage from floods and to ensure our industrial progress and the future prosperity of our people.
- "(2) That with respect to streams having their headwaters within the boundaries of the forest parks, all plans of regulation or power development should be executed only by the State, and all reservoirs and their appurtenances and the impounded waters should be the property of the State and under exclusive State control, and not be permitted to pass into private hands. Any such plan should embrace all necessary safeguards to ensure the proper protection of the forests.
- "(3) That with respect to any other streams flowing through any other public park or reservation of the State, such plans should likewise be executed by the State and it should retain exclusive ownership and control in order adequately to safeguard the State's interests.
- "(4) That further, as it is of great public importance that the water powers of the State should be developed in a comprehensive manner and that these natural sources of industrial energy should not become the subject of an injurious private control, such development should be undertaken by the State whenever such action appears to be feasible and for the general interest.
- "(5) That in any case of State development of water power provision should be made for the granting of such rights as may be proper, to use the power so developed upon equitable terms and conditions.
- "(6) That the State should not undertake any plan of regulation or water-power development save upon a basis which would make its investment a fair and reasonable one

from the public standpoint by virtue of practicable measures for ensuring such a return upon the State's outlay as would be equitable in the particular circumstances.

"(7) That any amendment of the Constitution at this time for the purpose of permitting any portion of the forest preserve to be used for any such purpose should, by its terms, or by appropriate reference, suitably define the property within the preserve which is to be used and the manner of its use. No amendment and no plan of development should meet with any favor which, after the most rigid scrutiny, does not afford absolute assurance that in no way will the public interest in the forests be parted with or jeopardized."

LEGISLATION.

In accordance with the requirement of the Fuller Act and the recommendations of the Governor, the Commission with its last annual report, submitted a draft of a bill for a general law. This draft was considered by the Legislature, hearings were given upon it, its provisions were thoroughly discussed and changes were made in certain particulars. In its final perfected form it provided a scheme of general conservation and development of water powers by the State, which in brief outline was as follows:

Any person may petition the State, through the State Water Supply Commission, to construct a storage reservoir. The petition must show that the reservoir will produce an annual net revenue to the State by the lease of the water stored or of the power generated thereby or by assessment for benefits resulting therefrom. The petitioner must guarantee to the State a gross revenue sufficient to pay operating expenses and interest and sinking fund charges upon the cost of the reservoir.

If the Commission has not already prepared plans covering the project, it must proceed to prepare them and if conflicting petitions are filed, it may co-ordinate them. Within thirty days after the filing of a petition or the completion of plans it must accept or reject the petition and give its reasons therefor. If the Commission approves a petition, it must lay it before the Governor, with the plans and estimates relating to it, and if the Governor approves it, he must within thirty days, direct the Commission to proceed to build the reservoir.

The Commission without petition may present to the Governor a reservoir project which will yield a net revenue to the State.

Any project involving a stream whose waters are used for canal purposes must be submitted to the Canal Board for a statement as to its effect upon the canals before it is submitted to the Governor.

Real estate required for the execution of the work may be appropriated upon notice when needed and if compensation cannot be agreed upon with the owner by the Commission, the Court of Claims is authorized to make an award which the Comptroller is directed to pay.

The work of construction must be done under contract approved by the Governor.

The Commission is authorized to make and enforce rules for the maintenance and operation of storage reservoirs.

The Commission may lease for terms of not more than fifty years the right to use water from any State storage reservoir or the power developed therefrom for a sum which shall not be less than the interest, sinking fund and operating charges, and the rental shall be a tax upon the property benefited.

In consideration of benefits to be conferred, the Commission may enter into a contract for a reasonable consideration with any person or corporation, municipal or otherwise, and the sum so agreed upon shall be a tax upon the property benefited.

When no contract exists, the Commission is directed upon the completion of the reservoir and at five year intervals thereafter to assess the value of the yearly benefit upon the property and the municipalities benefited, and the assessment shall be a tax upon the property or the municipality. Hearings must be given by the Commission upon assessments and its decisions may be reviewed in the manner provided by the Tax Law.

All moneys received must be paid into the treasury to the credit of a fund to be known as the State Water Storage Fund from which appropriations may be made for paying the cost of maintaining and operating reservoirs, for additions to the sinking fund to retire water storage bonds, for building other storage reservoirs and for deposit to the general credit of the State.

Bonds limited in amount to \$20,000,000, in interest to 4 per cent., and in term to fifty years, shall be issued by the State to provide funds for building storage reservoirs as money may be required for payments under contracts. Not more than \$2,000,000 may be issued in the year after the act takes effect, and thereafter the bonds shall be sold in lots of not more than \$1,000,000. For each \$1,000,000 of bonds outstanding, a State tax of twelve one-thousandths of a mill is imposed for the payment of the interest and sinking fund charges until the sinking fund shall equal the principal of the bonds, after which time the tax shall be reduced to an amount equal to the interest alone.

It is expressly declared that nothing in the act shall be deemed to confirm any right or privilege claimed, or to impair any right or power now belonging to the State. The Commission, for the State, is empowered to revoke any use of real estate for private purposes under the authority of or by sufferance of the State in cases where the State can revoke.

The bill, when approved by the Legislature and the Governor, must be submitted to the people for their approval in the general election of 1911 and will take effect only when approved by a majority of the voters who vote upon it.

The full text of the proposed general law will be found in Appendix D of this report.

While in the preparation of the bill the Commission was constrained to follow the directions given in the Fuller Act, it believes that the proposed measure, if adopted, will prove in operation to be of incalculable advantage both to the State and

to the owners of water power sites upon rivers whose flow can be regulated and equalized by the construction of storage reservoirs.

The Commission is aware of the fact that some of the riparian owners upon rivers whose full power capacity can be developed only by storage of water that now runs to waste expressed dissatisfaction with the measure during the last session of the Legislature. It believes that their opposition was short sighted, and that dispassionate consideration cannot fail to remove it. Public attention everywhere has been forcibly directed to the conservation and development of water powers as one of the most valuable of public resources. It seems to the Commission inevitable that in the near future this State must undertake the systematic development of this resource, and that, if the adoption of a fair and reasonable profit-sharing policy, such as that proposed by the measure which has been outlined, is rejected, the State may be driven into the position of a competitor with established private industries.

STATE CONTROL OF WATER POWERS.

Upon the question of the control of water power developments by means of water storage and the regulation of stream flow, there has been a divergence of opinion even among the riparian owners enjoying water power rights. The owners of such rights upon the upper Hudson and the Genesee rivers, the two most important available water power possibilities in the State, have signified their belief that the storage reservoirs should be owned and controlled by the State and also their willingness to pay in the form of rental or benefit assessment sums which would constitute an annual income to the State; the owners of water power rights upon the Black river and some other Adirondack streams, on the contrary, take the position that the State should build storage reservoirs even upon State land, and that after the cost has been paid by assessment upon the property benefited, they should have the right to the free and perpetual use of the resultant equalized flow.

The Commission in its previous reports has discussed at length the various considerations involved, reaching the conclusion that the public interest plainly requires State control of water power developments and a system of management which will enable the State to derive a revenue from the sale or lease of the additional water power made available by such developments, and with opportunity for a revision at suitable intervals of the terms of such sale or lease. A brief recapitulation of the reasons which have led to this conclusion may be given:

- (1) Water power differs from every other form of power, in that it is constant and perpetual. Its development, particularly in the form of electrical energy, is in its infancy. It is impossible to predict its future value. Sound public policy demands that, as its most valuable resource, the State should retain the largest possible measure of control, so that the power may forever be employed for the public benefit.
- (2) Experience everywhere proves conclusively that the prosperity of industries dependent upon water power is best served by State control, and all progress in legislation has been along this line.
- (3) The public interest demands that there should be the fullest possible development of water powers. Such development can be brought about only by the State, since in many cases economy would not warrant it in private enterprises.
- (4) The right to condemn lands for water storage purposes can be exercised only by the State and for the benefit of the public.
- (5) The financial strength of the State enables it to borrow money to pay the cost of the work at a lower rate of interest than it would be possible for individuals to obtain.
- (6) The State alone by assessment can compel each beneficiary of an improvement to pay a just proportion of the cost, and by State operation only can an equitable distribution of the stored water be made. Experience has shown that it is practically impossible for various reasons to combine competing private interests in the development and use of water power.
- (7) The sanitary conditions which should be taken into consideration in storage reservoir construction and operation cannot be assured through private construction and control.
- (8) Development and control by the State would promote new industries, while private development and operation promote existing industries only and tend to discourage new industries.

- (9) The safety of dams built for water storage can be assured only by State construction in which it would be paramount to any question of expense.
- (10) The supply of water available for power purposes is limited, thus creating a situation which invites the establishment of combinations tending to monopoly and harmful to the public interest. State control provides a complete barrier to such combinations.
- (11) The benefits to navigable streams which should result from water storage can be assured only through State ownership and control of storage reservoirs.
- (12) Under State control the shores of the lakes formed by storage reservoirs can be so treated and maintained as to make these lakes attractive health and pleasure resorts, thus benefiting surrounding communities instead of injuring them. Private owners have no business interest in this object and in fact pay little regard to it.
- (13) Many miles of navigation may be added to the waters of the State by State control by thorough clearing of reservoir sites and the retention of a sufficient minimum depth of water in the reservoir at all times. Private control does not preserve this advantage.
- (14) Storage under State control may be so managed as to bring about the establishment of new industrial communities by the utilization of the additional water power at or near the dam without diminishing the benefit to existing industries.
- (15) Water supplies for other than industrial purposes can be protected only through supervision by the State.
- (16) By the adoption of a definite and comprehensive State policy of control, the location of roads, railroads and buildings in prospective reservoir sites can be prevented and a large part of the expense in the eventual purchase of the site can be avoided. This cannot be accomplished in any other way.
- (17) Under State control the possible future needs of the canal system can be considered and economical provision made for them.
- (18) The State alone can plan a comprehensive scheme of water power development and execute it in accordance with the relative importance of each project.

(19) Through the establishment of State control and development upon well defined and reasonable terms it is probable that the people will consent to the use of the State land in the Adirondack Park, which is absolutely necessary to the development of some of the most valuable water powers, and it is unlikely that the use of the land will be permitted for the purpose of private development and control.

Losses Due to Delay.

In the prosecution of its work, the Commission has been hampered by the existence at the same time of a definite statute prescribing the method by which river improvements shall be made, even though they may involve water storage, and of a legislative command to prepare for the prosecution of water storage projects by an entirely different method. The industries which have suffered from a preventable lack of water power have sustained serious loss from the same cause.

Owing to the uncertainties of the situation the Commission deemed it its duty to delay action upon the applications for the improvement of the upper Hudson and of the Genesee rivers pending the passage of the legislation needed to embody in the statute the policy so definitely indicated by the Fuller Act, and in this position the power users upon these rivers acquiesced.

It was apparent to all that a waste of time and money would be caused by beginning an improvement under plans drawn in accordance with a statute which was about to be superseded by a different statute.

While complete statistics of the losses caused to industry by the absence of river regulation are not obtainable, partial statements have been made to the Commission by the representatives of power users in Northern New York. It is stated that during the summer of 1909 forty-two paper and pulp corporations in that portion of the State, representing an investment including capital stock, bonds, etc., of \$38,664,218 and a daily production of 1633 tons of paper, valued at \$64,095, and 1756 tons of pulp valued at \$37,499, were idle for a total of 2503 days on account of low water. The loss in value of product, as reported by the corporations, was \$3,707,069

and the loss in wages on account of enforced idleness was \$293,545.

Figures for eleven months of 1909 for three mills belonging to the International Paper Company were given by the representative of that company during a recent hearing as follows: At Corinth, where 633 men were employed, a daily average of 102 men were laid off; at Glens Falls, where 255 men were employed, a daily average of 177 men were laid off; at Fort Edward, where 363 men were employed, a daily average of 152 men were laid off. The loss in wages during that period was stated as \$257,544. The representative of the company added that not a day nor a dollar would have been lost if the flow of the Hudson had been regulated by means of water storage.

It is thus shown that while the delay has been injurious to the State owing to the fact that it has postponed the enjoyment of the benefits which will be derived from river regulation in the shape of improved navigation, decreased flood damages and better sanitary conditions, it has also proved a cause of serious loss to industry. In view of this situation the users of water power upon the two rivers mentioned have insisted upon procedure under the only existing statute, that is to say under the present law providing for river improvement. While it has seemed to the Commission that in fairness to the business interests involved longer delay should be avoided, nevertheless it is of the opinion that the best interests both of the State and of the owners of water power require the adoption of a comprehensive plan under which these improvements and others may be prosecuted upon terms more advantageous than the river improvement law permits.

NEW WATER POWER DEVELOPMENT.

The water power census made by the Commission in 1908 showed a total of 618,942 stated horse power in use at 1824 plants with a total capacity of 829,558 water horse power. Comparison of the results of this census with those of the United States Census of Manufactures in 1905 showed that during the intervening three years, there had been an increase of 172,790 horse power, or about 39 per cent. The increase since 1908 has been rapid.

Niagara River.

In the water power census of 1908, the horse power in use at Niagara Falls was stated at 145,400 and the total horse power capacity of the plants at 198,600 horse power. The water horse power now in use at Niagara Falls is 180,000 horse power and a bill is pending before Congress to permit an increase to 250,000 horse power.

As a result of protests made against a possible excessive diversion of water from Niagara Falls which might result in the impairment of their scenic beauty, negotiations for a treaty with Great Britain to limit the amount of water which might be diverted from the falls on both sides of the river were begun. Pending the conclusion of the treaty, Representative Burton of Ohio introduced a bill in Congress which became a law on June 29, 1906. law, known as the Burton Act, limited the amount of water that might be diverted from the falls on the American side to 15,600 cubic feet a second, and in order to discourage the taking of water on the Canadian side, it limited the amount of electrical current that might be imported from Canada to 160,000 horse power. the chief market for hydro-electric power developed in Canada was on this side of the river, the expedient proved effective. ton Act, which originally was limited to three years in its operation, was extended in 1909 two years more, and will expire on June 29, 1911.

On May 13, 1910, a treaty between the United States and Great Britain was proclaimed. It limits the diversion of water from the Niagara river at the falls to 20,000 cubic feet a second on the American side and to 36,000 cubic feet a second on the Canadian side. It makes no provision regarding the importation of electrical power from Canada.

To meet the situation which will be created by the expiration of the Burton Act, a measure has been introduced in Congress giving the existing companies the right to appropriate the 4,400 additional cubic feet of water a second which the treaty permits to be diverted on the American side of the river. This would yield from 40,000 to 50,000 additional horse power.

The right to use the waters of the Niagara river for power purposes was granted originally by the State without provision for compensation to the State for the privilege. Objection has been made to the pending bill on the ground that it proposes to give the right to use the additional water allowed by the treaty without compensation either to the State or to the National Government. It has been suggested that advantage be taken of the opportunity to impose conditions with respect to compensation which will be more in accord with the present view of the terms upon which water power privileges should be granted than were the terms of the original grants made by the State.

Lake Erie Storage.

Water storage in Lake Erie by means of a dam at the Niagara river outlet is contemplated in plans which are being prepared by the International Waterways Commission. On this subject the Secretary of War in his annual report for 1910 said:

"Among the various duties which were enjoined upon the commission, it was specifically required that they should 'report upon the advisability of locating a dam at the outlet of Lake Erie, with a view to determining whether such dam will benefit navigation.' The term dam as here used may apply to either regulating works or compensating works. Regulating works are those designed to raise the low water without raising the high water surface; that is, to reduce the amount of oscillation in the lake's level. Compensating works are those designed to raise the general level of the lake, at high water as well as low water, without essential change in the amount of oscillation. The former being the more desirable, if feasible, have been the subject of careful investigation by the commission for several years. The conclusion which they reached being adverse to this class of works, it became necessary for them to consider the second kind, and as this involved considerable further delay they submitted the results of their studies upon the first branch of the subject in a report dated January 8, 1910. This report was forwarded by me to the President and was by him transmitted to Congress by his message of March 14, 1910. * * investigation of the second branch of the subject additiona. surveys have been found necessary. Of these the field work has been completed, and the construction of the maps has made good progress. The commission expects to submit a report upon compensating works for the outlet of Lake Erie during the coming year."

St. Lawrence River.

Water power in actual use in the St. Lawrence river, including the Oswegatchie, Grasse, Raquette and St. Regis rivers, was found to be 86,313 horse power by the water power census of 1908 at 158 plants with a total capacity of 115,583 horse power.

Application has been made to Congress for permission to develop from 600,000 to 650,000 horse power at the Long Sault on the St. Lawrence river. The consent of Canada must also be obtained before the project, which is to represent an investment of from \$40,000,000 to \$50,000,000 can be carried out. The Long Sault Development Company was chartered by the State of New York in 1907 to develop the power on the American side and the St. Lawrence Power Company was incorporated in the Province of Ontario to make the development on the Canadian side. Both are said to be controlled by the Aluminum Company of America, which is to employ the power for the extraction of aluminum from clay obtained in Arkansas. For this purpose the company is now operating a plant of from 35,000 to 40,000 horse power at Massena.

The grant made to the Long Sault Development Company in 1907 gave perpetual right to use the water upon the following terms:

After Congress has authorized the construction of the development works and after the payment of \$10,000 by the company to the State, the Commissioners of the Land Office shall grant land under water actually required for the development works. The company was required to pay to the State \$15,000 for the year 1910, and \$20,000 for the year 1911, after which the company is required to pay annually to the State seventy-five cents for each electrical horse power generated up to 25,000 electrical horse power; fifty cents for each electrical horse power generated over 25,000 electrical horse power and up to 100,000 electrical horse

power; and twenty-five cents for each electrical horse power generated over 100,000 electrical horse power. If the corporation shall use the water power without transforming it into electrical power then the rates specified for electrical power shall be applicable to the water power used. After the year 1911 the company is required to pay at least \$25,000 a year to the State.

Authority was granted by the Public Service Commission for the Second District to the New York and Ontario Power Company of Waddington on January 14, 1909, to issue \$600,000 common capital stock and \$1,850,000 bonds for the development of 30,000 continuous water horse power from the St. Lawrence river.

Salmon River.

For the purpose of developing 15,000 horse power at Salmon River Falls, the Oswego County Light and Power Company was authorized by the Public Service Commission for the Second District, on May 27, 1909, to increase its capital stock from \$100,000 to \$1,000,000 and to issue fifty-year bonds to the amount of \$2,-353,000.

Deer River.

Development of 1,740 water horse power on the Deer river at High Falls in Copenhagen by means of the construction of a dam, was provided for in the authorization granted to the Deer River Power Company on August 11, 1909, by the Public Service Commission for the Second District. The Company asked leave to issue \$25,000 capital stock. The existing water power development at Copenhagen was shown by the water power census of 1908 to be 155 horse power.

Garoga Creek.

By the construction of a dam at Garoga, in Fulton county, the Mohawk Hydro-Electric Company proposes to develop 7,600 water horse power which will be used to generate electricity for light, heat and power purposes. The dam, which is practically completed, will create a large storage reservoir. This is a new development.

East Canada Creek.

An increase of water power development from 467 horse power, as shown in the water power census of 1908, to 15,000 horse

power, is proposed by the East Creek Electric Light and Power Company. The development is planned to be made at Ingham's Falls in East Canada creek. The Public Service Commission for the Second District on April 21, 1910, authorized the company to increase its capital stock from \$200,000 to \$500,000 and to issue bonds to the amount of \$1,750,000 to meet the cost of the work.

TREND OF PUBLIC SENTIMENT.

The trend of public sentiment in favor of State ownership, development and control of water power resources has been unmistakably indicated during the last few years. The agitation for the establishment of this principle has been widespread and has met with a ready response.

In the declaration of principles, adopted by the Conference of Governors in Washington, in May, 1908, the following principles were affirmed:

"We declare our firm conviction that this conservation of our natural resources is a subject of transcendent importance, which should engage unremittingly the attention of the Nation, the States, and the people in earnest cooperation. These natural resources include the land on which we live and which yields our food; the living waters which fertilize the soil, supply power, and form great avenues of commerce; the forests which yield the materials for our homes, prevent erosion of the soil, and conserve the navigation and other uses of the streams; and the minerals which form the basis of our industrial life, and supply us with heat, light, and power. We recognize in our waters a most valuable asset of the people of the United States, and we recommend the enactment of laws looking to the conservation of water resources for irrigation, water supply, power, and navigation, to the end that navigable and source streams may be brought under complete control and fully utilized for every purpose."

The North American Conservation Congress held in Washington in February, 1909, and participated in by Commissioners representing the United States, the Dominion of Canada, the Ro-

public of Mexico and the Colony of Newfoundland, in its declaration of principles adopted the following:

"We recognize the waters as a primary resource, and we regard their use for domestic and municipal supply, irrigation, navigation, and power, as interrelated public uses, and properly subject to public control. We therefore favor the complete and concurrent development of the streams and their sources for every useful purpose to which they may be put.

"The highest and most necessary use of water is for domestic and municipal purposes. We therefore favor the recognition of this principle in legislation, and, where necessary, the subordination of other uses of water thereto.

"The superior economy of water transportation over land transportation, as well as its advantages in limiting the consumption of the nonrenewable resources, coal and iron, and its effectiveness in the promotion of commerce, are generally acknowledged. We therefore favor the development of inland navigation under general plans adapted to secure the uniform progress of the work and the fullest use of the streams for all purposes. We therefore express our belief that all waterways so developed should be retained under exclusive public ownership and control.

"We regard the monopoly of waters, and especially the monopoly of water power, as peculiarly threatening. No rights to the use of water powers in streams should hereafter be granted in perpetuity. Each grant should be conditioned upon prompt development, continued beneficial use, and the payment of proper compensation to the public for the rights enjoyed; and should be for a definite period only. Such period should be no longer than is required for reasonable safety of investment. The public authority should retain the right to readjust at stated periods the compensation to the public and to regulate the rates charged, to the end that undue profit or extortion may be prevented.

"Where the construction of works to utilize water has been authorized by public authority, and such utilization is necessary for the public welfare, provision should be made for the expropriation of any privately owned land and water rights required for such construction.

"The interest of the public in the increase of the productiveness of arid lands by irrigation and of wet lands by drainage is manifest. We therefore favor the participation of the public to secure the complete and economical development and use of all water available for irrigation and of all lands susceptible of profitable drainage, in order to insure the widest possible benefit special projects to be considered and developed in connection with a general plan for the same watershed. In the matter of irrigation, public authority should control the headwaters and provide for the construction of storage reservoirs and for the equitable distribution and use of the stored water."

The National Conservation Association advocated the following:

"The preparation, by a commission appointed by the President of the United States, of a comprehensive plan for waterway improvement, extending to all the uses of the waters and the benefits to be derived from their control, including navigation, with the relation of railroads and terminals thereto, the development and disposition of water power, the irrigation of arid lands, the drainage of swamp and overflowed lands, the control of floods, the prevention of soil wash, and the purification of streams for water supply.

"The immediate undertaking and continuous prosecution of works clearly necessary under such general plan.

- "The incorporation into all future grants of water power rights by state or nation of provisions to secure the following:
- "(a) Prompt development on pain of forfeiture of the grant.
- "(b) Payment of reasonable compensation for the benefits granted by the people with periodic readjustment of the rate of compensation, so as to insure justice both to the investor and to the public.
- "(c) The limitation of all such grants to periods not exceeding fifty years, and the reservation of the right to ter-

minate and acquire or reconvey the grant for proper cause and upon equitable compensation; together with proper inspection and publicity of records and accounts.

"(d) Recognition of the right of the appropriate public authorities to make reasonable regulations as to rates of service.

"The termination of all existing permits or grants for the development of water power and the substitution of new grants involving the foregoing principles as soon and to such extent as may be consistent with the terms of the existing grants.

"The support and extension of the irrigation of arid lands and the drainage of swamp and overflowed lands."

CONSTITUTIONAL LIMITATIONS.

It was the influence of this sentiment at its beginning that put the hard and fast amendment of section 7 of Article VII into the Constitution of the State.

This amendment has no doubt tied up and delayed forest culture in the Adirondacks on State lands; it also stands in the way of conservation on any broad and systematic plan by the storage of flood waters.

This sentiment has not abated, but has increased in intensity during the ten years past, and gathered fresh vigor in favor of State development and ownership for a public revenue. No plan that does not recognize such a policy can induce the people to change its fundamental law by amending section 7 of Article VII of the Constitution.

This Commission is convinced not only from public sentiment, but by careful study of the principles of conservation and of the duty of the State toward such an enterprise, that the building of storage reservoirs is a proper function of State government, and that such reservoir building should have in view a direct revenue to the State aside from the indirect benefit to individuals, corporations and municipalities and other civil divisions of the State.

We believe that when the people come to understand the plan of the Commission for conservation and water storage, they will willingly consent to such a change in the Constitution as will permit the storage of flood waters.

PUBLIC AND PRIVATE RIGHTS.

There is controversy over the extent of public and private rights in the waters within the State. It is hardly necessary to say that private rights cannot be infringed, nor can private property be taken without compensation and due process of law. The uncertainties of the situation make it difficult to frame legislation which will protect all interests. Many of the States have sought by constitutional provision to define the limits between public and private ownership, and it is possible that this State eventually may find it advantageous to adopt this plan.

CONTROL BY THE FEDERAL GOVERNMENT.

Advocates of the extension of Federal powers have suggested that the national government may properly build water storage reservoirs upon navigable streams to which jurisdiction extends under the authority granted to it by the United States Constitution to regulate commerce between the States, and it has even been urged that the national government might construct reservoirs for storage upon the headwaters and the tributaries of such streams as well as upon streams which form the boundary between States. There is no Federal law authorizing the building of reservoirs for water power purposes, but surplus water from reservoirs built by the Nation for the regulation of river flow in the interest of navigation and for irrigation may be sold to water power users. Under this authority 3,243 water horsepower was sold in 1908 by the Federal government for \$5,600. The sales were made chiefly from reservoirs built to regulate the flow of the Ohio river.

An important instance of Federal water power development in this State is involved in the construction of the proposed new dam at Troy as part of the Federal plan for improving the navigation of the Hudson river. The surplus water from the present Troy dam, which was built as a part of the canal system, has been sold by legislative grant for the nominal price of \$300 a year to a water power company for the use of industries in Troy. It is proposed that the State shall abandon its rights in the water power to the national government in consideration of the Federal expenditure to be made upon the Hudson. The government may then sell the surplus water stored by the new dam.

The utilization of Niagara Falls for water power has been limited by a treaty between the United States and Great Britain under the terms of which a maximum of 20,000 cubic feet a second may be taken on the American side and 36,000 cubic feet a second on the Canadian side. This treaty provides that the level of Lake Erie must be maintained.

Canada exacts rentals for the use of water power at Niagara Falls as follows: 10,000 horse power, \$15,000 a year; over 10,000 horse power and under 20,000 horse power, \$1 per horse power per year; over 20,000 horse power and under 30,000 horse power, 75 cents per horse power per year; all over 30,000 horse power, 50 cents per horse power per year.

METHODS OF PUBLIC CONTROL.

Inquiry into the laws and regulations of other countries in relation to the development and use of water power reveals a uniform tendency toward the assumption of public control, the limitation of grants and the exaction of a rental for use. In some cases the government reserves the right to purchase the plant at cost at the end of a specified number of years.

Switzerland and the Province of Ontario, Canada, may be selected as affording examples of well developed although diverse policies. One has taken possession of the water powers within its borders; the other, following the English law of riparian ownership, has left the water powers in private control but has assumed the task of distributing the power when converted into electrical energy.

Switzerland is prolific in falling water capable of transformation into electrical energy. Before 1908 the flow of the streams belonged to the several Cantons, and concessions for water power development were granted on the basis of annual payment to the State. The national government assumed general jurisdiction over the streams in 1908 through an amendment to the Constitution which was approved by the people by a vote of 292,997 to 52,180. This amendment is as follows:

"Article 24b. The Federal Congress shall have supervision over the development of water powers.

"The Federal Congress shall make provision for the distribution of water-right concessions, shall prescribe the terms thereof, and shall regulate the transmission and distribution of electrical energy so far as may be necessary to protect public interests and to provide for the proper development of such resources.

"All water-rights to which the terms of the Federal law do not extend shall be under the jurisdiction of the Cantons, which shall dispose of the concessions, regulate the same, and impose taxes and fees for their use, but such regulations, taxes, and fees shall not be so severe as to prevent or inhibit the development of water powers.

"The national government shall regulate and dispose of concessions for powers located on intercantonal and national boundary streams, and shall determine the taxes and fees to be imposed thereon, after hearings have been granted to the Cantons interested, but such taxes and fees shall be collected by the Cantons.

"No power developed on a stream located within the Union shall be transmitted to a foreign country without the consent of the Federal Council.

"The provisions of the Federal law shall apply to waterright concessions already existing, except in cases specifically exempted therefrom by law."

The province of Ontario until 1898 made no reservation of water powers in grants of public land. A law passed in 1898, however, reserved all water powers of more than 150 horse power minimum and provided for the leasing of such powers upon the following conditions: (1) Payment of an annual rental; (2) development within a specified time; (3) the supplying of surplus power to those requiring it upon conditions and rates to be determined by the government; (4) full development whenever the government decides that there is a demand for the power. Under this act, at the beginning of 1910, twenty water powers had been leased with a minimum development of 26,600 horse power and a maximum of 53,700 horse power, at an annual rental of \$12,000.

Complaint was made in 1900 that the water powers of the Province were falling into the control of monopoly and that excessive rates were being charged for power. After much agitation, the Hydro-electric Power Commission of Ontario was created in May, 1906. It is authorized to collect and report information regarding water and electrical powers, and upon power and lighting needs. With the authority of the Lieutenant-Governor-in-Council it may purchase, lease or condemn lands, water powers, water privileges, electrical current and power and distributing plants which it may operate. It may make contracts with municipal or other corporations to supply power or light. controlling the rates charged by them, and it may borrow money for these objects. The Commission has contracted for the purchase from the Ontario Power Company at Niagara Falls of from 8,000 to 100,000 horse power at the rate of \$9.40 per horse power per annum up to 25,000 horse power, and \$9 per horse power per annum above 25,000 horse power. This current is sent over transmission lines to the various cities in the southern part of the Province. The rates charged vary from \$18.10 to \$29.50 per horse power per annum according to distance. Fifteen municipal corporations were being supplied with an aggregate of 27,000 horse power in January, 1910. The plan has worked well as, while local prices have been reduced, the demand has been stimulated so that the private companies are prospering.

Canal and Highway Improvement.

It has been contended that as the State is expending large sums of money for the enlargement of the canals and for the construction of good roads, it should likewise bear the entire cost of water storage for power purposes. This argument is fallacious. The canals and the highways are open to the use of every citizen of the State without preference; the increased flow of streams, owing to the nature of the natural monopoly residing in water power sites, can be used only by the few who enjoy exclusive privileges therein. They are not even open to competition, since they cannot be sold to the highest bidder. Moreover, the canals paid to the State in tolls, up to the time when tolls were abolished in 1882, the sum of \$134,900,020.58. The State may at

any time, by constitutional amendment, re-establish tolls for the use of the canals and it may also exact tolls for the use of State highways; but when once it has alienated its rights in the streams it cannot recover them, excepting by purchase.

The plans for the enlargement of the canals and the construction of improved highways were submitted to the people of the State in referendum measures for their approval, and they received the sanction of the people. Certainly no plan for water storage at public expense should be adopted without similar sanction.

A large proportion of the industries using water power, especially in the northern part of the State, obtain their raw material from the forests. Much of the supply of this raw material has been furnished by the State, either from State lands or from lands which the State has permitted to pass temporarily from its ownership so that the timber thereon might be used. The consumption has outdistanced the supply which at present has become depleted, but with the adoption of a system of scientific forestry it will in large measure be renewed, greatly to the benefit of the industries to which reference has been made. This benefit should make them the more willing to pay the State reasonable compensation for the increase in power which they desire.

The payment of this compensation will not be made by the industries, but by the consumers of their product. The extremely favorable terms upon which it has been proposed to supply the additional power will leave manufacture a large margin of profit from its use after the State has been reimbursed. For example, it has been suggested that water power be leased annually at from \$5 to \$10 per horse power. Each such additional horse power is worth to manufacture from \$20 to \$25. In the form of steam it costs annually from \$40 to \$45 per horsepower.

INCREASE OF STREAM FLOW.

It may be argued with force that to increase the flow of a stream by means of a storage reservoir constructed and controlled by the State is in reality a new grant of water power made by the people to every water power site upon the stream below the dam. The flow of the stream is made up of the runoff from a drainage area usually embracing several hundred and sometimes upward of a thousand square miles. The surplus water is impounded by the State in a basin taken from private owners by eminent domain — that is to say, for a public benefit. Usually it can be acquired in no other way. The reservoir is built with public money at a less cost than private construction would involve.

On this theory it would seem only fair that those who obtain a direct financial benefit from the exercise of the authority of the State should be willing not only to repay the State for its outlay but to contribute to the public treasury a small share of the increased annual profits which the interference of the State has enabled them to make. And it certainly is not unreasonable that the benefits received under leases should be reappraised and the rate of payment therefor readjusted once in a generation.

In connection with the construction of the Chicago Drainage Canal, at an estimated cost of \$20,000,000, it is proposed to make a fourteen-foot channel to the Mississippi river, capable of producing 140,000 horsepower, of which at least 100,000 horsepower will belong to the State. The plans contemplate the lease of this power at the rate of \$25 per horsepower per annum, thus creating an annual income of \$2,500,000, or enough to extinguish the total debt with interest in seventeen years, after which time it is estimated that the State will derive an income from the work of \$2,750,000 a year.

Hydro-electric power can be sold in New York State, because of the favorable conditions, at one-half the rate that must be charged in North and South Carolina and in California.

DANGER OF MONOPOLY.

Water power development from its nature is peculiarly liable to the establishment of a monopoly. It cannot be increased beyond a certain point and it can be used only by the possessors of water power sites. Its immense advantage over any other form of power and the fact that it is inexhaustible within the limits of its development have led those in a position to appreciate its value to obtain control of the greatest possible share. The United States Commissioner of Corporations has stated that thirteen companies

already control 1,825,000 horsepower, or more than one-third of the entire development in the United States.

In his veto of a bill authorizing the construction of a dam for water power purposes across the James river in Missouri, President Roosevelt, in January, 1909, called attention to the tendency to monopoly in the control of water power rights. After quoting from the report of the Commissioner of Corporations, he said:

"The movement is still in its infancy, and unless it is controlled the history of the oil industry will be repeated in the hydro-electric power industry, with results far more oppressive and disastrous for the people. It is true that the great bulk of our potential water power is as yet undeveloped, but the sites which are now controlled by combinations are those which offer the greatest advantages and therefore hold a strategic position. This is certain to be strengthened by the increasing demand for power and the extension of long-distance electrical transmission.

"It is, in my opinion, relatively unimportant for us to know whether or not the promoters of this particular project are affiliated with any of these great corporations. If we make an unconditional grant to this grantee, our control over it ceases. He, or any purchaser from him, will be free to sell his rights to any one of them at pleasure. The time to attach conditions and prevent monopoly is when a grant is made.

"The great corporations are acting with foresight, singleness of purpose and vigor to control the water powers of the country. They pay no attention to state boundaries and are not interested in the constitutional law affecting navigable streams except as it affords what has been aptly called a "twilight zone," where they may find a convenient refuge from any regulation whatever by the public, whether through the national or the state governments.

"* * The new legislation sought in their own interest by some companies in the West, and the opposition of other companies in the East to proposed legislation in the public interest, have a common source and a common purpose. Their source is the rapidly-growing water power combination. Their purpose is a centralized monopoly of hydro-electric power development free of all public control."

Legislation passed during the last session of Congress upon the recommendation of President Taft has brought about the withdrawal from entry of a large number of important water power sites on public lands in the West.

The reservation of water power sites during President Taft's administration covers 1,456,899 acres and many power sites on 135 rivers in eleven States.

In California, according to a recent statement of the United States Commissioner of Corporations, four hydro-electric companies, with 259,000 developed horsepower and probably 500,000 horsepower undeveloped, dominate the water power industry. Similar conditions exist in the Puget Sound territory, in Colorado, Montana, the southern peninsula of Michigan and the Carolinas.

Fortunately, the State of New York hitherto has escaped these conditions, largely, no doubt, because it owns the chief sources of water power in the Adirondack Park, and because it has withheld the right of eminent domain from water power companies.

The control of the Public Service Commissions over electrical power companies with respect to their rates, mergers and issues of securities is a further safeguard of the highest importance.

WATER POWER AND THE BARGE CANAL

In the general plan for the conservation and utilization of water powers provision should be made by general enactment for the lease of the right to use surplus water impounded by the State in reservoirs built to store water for the Barge Canal. Provision should also be made for minimum rates and frequent readjustment. The methods by which these surplus waters have been disposed of in former years have been short-sighted and unbusiness-like. The Legislature in 1907 passed an act forbiding the making of any contract for the use of them until the final completion of the Barge Canal improvement, so that the situation is favorable for the establishment of a general policy regarding them.

In its last two annual reports the Commission called attention to the fact that water storage projects which are being executed to supply the Barge Canal with water involve questions of water power development and flood prevention. The conditions which make it impossible to include such canal work in a comprehensive scheme of water power conservation and river regulation are unfortunate.

A large storage reservoir with a dam near Hinckley is being constructed on West Canada creek. The present law gives no authority to provide for the regulation of the creek beyond the regulation incidental to the storage of water for the canal and for maintaining the minimum flow of the creek for the use of the power developments that are dependent upon it. This will conserve only about one-fourth of the total amount of water power that might be obtained from the reservoir, which might easily be made larger than is now contemplated, thus giving an opportunity for the development of water power sites below the dam that are at present undeveloped. No use will be made of other favorable storage sites on the creek, although the location of the stream in relation to populous communities assures a market for power. Serious floods have occurred upon the creek, especially near Herkimer, but it is impossible to make provision for their abatement through the construction of the Barge Canal reservoir.

The water taken from the creek for the canal is to be permanently diverted and carried for several miles in the channel of Nine Mile creek. There is a fall of about fifty feet where the diversion channel reaches the bed of Nine Mile creek, but by extending the channel for a short distance a fall of about 300 feet might be obtained, making possible the development of at least 5000 continuous horsepower.

Other illustrations are given in the report of the Consulting Engineer of the loss which must result from the fact that the law providing for the improvement of the canal did not take into account the possibilities of incidental water power development.

The danger of unwise disposition of the surplus water power created by storage reservoirs built in connection with the canals was illustrated in a bill presented to the last Legislature by the representatives from the Cohoes district. The State is constructing in the Mohawk river above the Cohoes falls a costly canal dam which is known as the Crescent dam. The bill gave a private water power company the exclusive right to use the power

created by this dam, together with the privilege of using State land for the construction of a power plant and transmission lines, at a rental of from \$3000 to \$7500 a year. Referring to this bill, the State Engineer and Surveyor said:

"I do not believe that any water power created by the Barge Canal should be disposed of, except under a general law which would cover all cases. I believe that such powers should be disposed of under conditions which will permit of competitive bidding so that the State may receive for its natural resources, developed by the expenditures of the State's money, an adequate return for its investment, and that these resources so developed may accrue to the benefit of all the people of the State rather than to one or two individuals or corporations.

"I further believe that the powers thus created should not be disposed of except under lease for a limited period of years."

The measure failed to pass the Legislature, but it is obvious that in the absence of a settled and well-defined policy such valuable water powers may be disposed of piecemeal in the future as they have been in the past.

The revenue which might be derived from the lease of water powers created by the Barge Canal improvement is shown in the following table:

SUMMARY OF PRINCIPAL WATER POWERS CREATED BY BARGE CANAL.

	Distributed H. P. wit cal develo	th economi-	Annual re	turn for inc	rease if lease below.	ed at rates
LOCATION	Present	With Barge Canal	Increase	\$1.00 per H. P. year	\$3.00 per H. P. year	\$5.00 per H. P. year
Lockport! Rochester2 Baldwinsville Oswego River Vischer's Ferry Crescent Waterford. Total	1,700 2,452 33,960 None None None	4,530 9,732 2,640 41,649 6,530 6,980 6,506	3,130 9,732 188 7,689 6,530 6,530 6,506 40,755	\$3,130 9,732 188 7,689 6,530 6,980 6,506	\$9,390 29,196 564 23,067 19,590 20,940 19,518 \$122,265	\$15;650 48,660 940 38,445 32,650 34,900 32,530 \$203,775

¹ Distributed power from water by-passed in winter and summer under 50 feet head waste assumed to remain as at present.

2 Power from water wasted into Genesee river under 250 feet head.

Conclusion.

The people of this State looking back into its politico-economic history see a political division of the Nation so located and favored by natural conditions, that a virile, industrious and farseeing population quickly made it an empire in influence and wealth, and the most populous and wealthy of all the States in the Union.

A mere glance at the State's political, industrial and economic history attracts and interests the investigating mind. It looks at its beginning, it studies its statutes, it investigates the grants received from the mother country, it reads the charters it has given to its own subjects, which became the State's political children, it admires the rapid growth of these corporations and is proud, as it has a right to be, of their success.

Such a mind cannot limit its investigation to grants, charters, statutes and books; it is compelled to find out if it can what part nature played in this marvelous development which has made us the first State of the Union and what, if any, were the rights of the people in the vast natural State resources. No honest history of the State's prosperity can overlook the fact that New York harbor, the Hudson river, the Adirondack mountains, the water falls, the natural route for a highway from tidewater to the lakes—the Erie canal—and many other natural advantages, contributed in no small way to such success.

Did the deep and safe harbor surrounding Manhattan island belong alone to those worthy Dutchmen who first settled here? The answer is no, and that the State very early in its history so declared by giving the exclusive right to navigate it to a company of its own choosing. Broader minds determined that the rights of so great a natural resource extended far beyond the shores of New York and that the harbor was a part of the great national domain. As such it belonged to any member of the Union who cared to anchor his boat in its waters.

Do the deep and slow moving waters of the Hudson belong to the riparian owner? The answer is quickly no. That it is a navigable stream; that the common law and law of nature and of nations is contrary to such an ownership. Are the mountains, falls and other natural resources the property of adjoining or adjacent owners, or have the people of the State an interest in these resources? The answer under our law will depend upon the local condition at the particular location. Is the river boundary of the adjacent owner governed by the common or civil law?

Whatever the facts may be, the adjacent owner during a long series of years has come to believe that he has a legal right which no power can wrest from him. The fact that ever increasing drought is yearly diminishing the value of his rights as he claims them to be does not change his view as to his legal status, and perhaps it ought not. Although he is powerless to do anything to restore his property to its former value, and must see it continually and surely grow less, he is not yet ready to concede that the State has any right to increase by any means whatever, the value of his property. Such is the question that must be met if the natural resources, by means of storage reservoirs, are to be conserved in this State.

No policy of the State should be anything but wise and just to all of its citizens. It cannot afford to confiscate any one's property, neither can it afford to permit any property right, be it great or small, to stand in the way of material and needed progress, if such progress is made with due consideration of the rights of persons affected.

On all of those streams not navigable, where the common law controls, the adjacent owners of land own the bed to the center of the stream and have the right to the use of the natural flow of the river. This right is so entrenched in our jurisprudence that a person may be prohibited from interrupting the natural flow of a stream to the damage of the adjacent owner. This right to the flow of a river is as sacred as the ownership in any other species of property. He may dam the river and control the flow in any reasonable manner he likes so long as he does no damage to others and does not interfere with the rights of others whose right to use the waters are as extensive as his. He may impound the water and hold it captive to turn his wheels, under the restrictions as above, at will. He can utilize the full fall on his land. For all the years of the State's history these water

rights have been respected and used in the industrial development of the State.

When the country was new - the forest extensive and the streams even in their flow throughout the year - the water powers bore an important part in the State's enterprises. Scarcely a stream in the State that was not harnessed to some water wheel which furnished the power to an industry. In many instances they became the basis of great manufacturing centers. As the years went by and as the forest was felled and as the even flow of the streams ceased, and as the local demand for power gave way, water for power purposes was finally abandoned, except on the large rivers and at favorable sites. At one time it was thought that water for power purposes would be abandoned entirely. Those whose use of it taught them the advantage of water over coal for power purposes were slow to concede to the opinion that all power plants must soon be abandoned. These owners kept pace with electrical development - they were quick to see the value of the discovery which enabled electricity to be carried a long distance for commercial purposes. They were encouraged by the scientific investigation of rainfall, runoff and stream gauging. The high floods in the spring of the year, the low water during the dry season, the increasing price of coal, the constant and growing demand for more water set not only the owner of power plants but also the State to studying the subject of water for power purposes.

These studies, which have been conducted with thoroughness and scientific accuracy, make it possible to compute the value of the present flow of the large streams at the wheels and also enable us to calculate the value of an increase in the regulated flow of such rivers.

Its lakes and rivers constitute, next to its soil, by far the most valuable of the natural resources of the State. The advantage which it enjoys in these possessions is indicated by the fact that large amounts of capital have been attracted from outside its borders for investment in their exploitation.

The extension and prosperity of the industries which are dependent upon water power are important, but vastly more important is the economic welfare of the State as a whole. Within two decades the industrially vital character of water power has been in part revealed. Its transformation into electrical energy, already capable of being transmitted 200 or 300 miles, is revolutionizing manufacture. Only a few years ago its benefit was confined to the borders of the streams which supplied it; now it is spread abroad over the State. The time seems not far distant when the prosperity of every industrial establishment will flourish or languish in accordance with its ability to obtain electrical power in sufficient quantity to meet its needs and upon terms permitting its use. The situation, therefore, involves not only the ultimate stability of a tremendous aggregate of enterprise, but what is even more important to the State, the happiness of that large portion of the population that is directly or indirectly dependent upon that stability.

It may not be going too far to say that upon its wisdom in dealing with this priceless gift of nature will hinge in important degree the future commercial supremacy of the State.

Within the memory of the present generation the public forest lands were being given away almost for the asking. They were not then believed to possess any value worth considering from the public viewpoint. The State to-day is buying back the lands upon which the forests grew, paying many times the sums for which it might once have purchased them, forests included, for the privilege of controlling them and protecting them until new forests shall have time to grow during the next sixty or seventy years. In a similar manner the State has permitted many of its most valuable water power sites to pass into private ownership. It seems certain that the time must come when it will buy them back again, as it is now buying back its denuded forest lands, and the price will be no trifle.

It is evident that in shaping its policy relating to water powers, the State must go either forward or back—it cannot stand still. The hardships and losses resulting from inactivity cannot be continued indefinitely.

In its efforts to promote the wise solution of the problem, the Commission has endeavored to keep steadily in view the best interest of all the people of the State. To take any other attitude, it has felt, would be a grave dereliction of duty.

It has not been unmindful of the urgent immediate necessities of the industries which have felt most sharply the pinch of the present situation. Their impatience is natural and their criticism of delay in the application of the obvious remedy, in so far as they themselves have not been responsible for the delay, is justifiable. If it has happened that some part of the criticism has been directed at the Commission, it can be borne with equanimity in the confidence that the future will amply justify the course that has been taken.

RECOMMENDATIONS.

The Commission recommends with regard to water storage for water power purposes as follows:

(1) The enactment and submission to the voters of a general law providing for systematic development of water powers upon the principles laid down in chapter 569 of the Laws of 1907, and authorizing a self-extinguishing bond issue of not more than \$20,000,000 in total amount.

The draft of a bill for a general law submitted to the last Legislature by the Commission in accordance with the requirements of the statute, as elsewhere printed in this report, is commended for consideration.

- (2) The extension of the jurisdiction of the Commission to all storage reservoirs now owned by the State and not operated in connection with the canals, to the end that such reservoirs may be kept in repair and operated for the regulation of stream flow in the public interest.
- (3) Appropriation for the continuance of surveys, stream gauging, rainfall measurement and the preparation of plans for water power development.

The valuable studies of possible new developments of water power, which are contained in the report of the Consulting Engineer, are recommended for careful consideration. After reviewing the situation the Consulting Engineer says:

"With the Niagara developments at the western end of the State, the Hudson developments at the eastern end and the developments on the Genesee, Oswego and Black rivers and Canada creeks, there is evidently enough power available to make New

York the manufacturing center of the United States. When this fact is considered in connection with the magnificent and unexcelled transportation facilities by canal and rail alongside of which this power may be delivered, and the large urban population in the midst of which the power can be used, thus insuring a labor supply, it is clear that the only thing preventing New York State from becoming such a center is New York State herself."

In this conclusion the Commission fully concurs.

Respectfully submitted,

HENRY H. PERSONS, JOHN A. SLEICHER, MILO M. ACKER, CHARLES DAVIS, ROBERT H. FULLER,

Commissioners.

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REPORT OF WALTER McCULLOH, CONSULTING ENGINEER.

ORGANIZATION.

MUNICIPAL WATER SUPPLIES.

RIVER IMPROVEMENT.

WATER STORAGE AND WATER POWER.

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REPORT OF WALTER McCULLOH, CONSULTING ENGINEER.

ALBANY, N. Y., December 31, 1910.

To the State Water Supply Commission, Albany, N. Y.:

Gentlemen.—My report for the year ending December 31, 1910, is respectfully submitted hereunder.

ORGANIZATION.

Owing to the completion of the engineering work undertaken in 1909, and the practical depletion of the appropriation for surveys and investigation under the Fuller Act, the force of engineers was reduced on February 1, 1910, to an assistant engineer, two draftsmen, and two tracers for office work.

Upon the passage of the supply bill, making a further appropriation for the continuation of surveys and investigations and river improvement investigations, an allotment was made for the various branches of the work as follows:

Hydrographic work — stream gaging	\$7,500
Hydrographic work — rain gaging	1,500
Hydrographic work — evaporation studies and inci-	
dentals	1,000
Maintenance of the Albany headquarters office	10,000
For power surveys and investigations in the eastern	
and southern divisions of the State	10,000
For power surveys and investigations in the western	
and central divisions of the State	15,000
For collecting data and making investigations in re-	
gard to irrigation and small power developments	2,000
Reserve for contingency	3,000
Total appropriation	\$50,000

Your Commission thereupon directed your Engineers to undertake the following work for the season of 1910.

Surveys and investigations for power possibilities referred to in our previous reports on the Black river and its tributaries, the Oswego-Seneca river and its tributaries, including the Finger lakes; also a complete power survey on the Hudson river from Troy to Hadley, and a similar power survey on the Genesee river.

The Engineering Corps has been organized as follows with men in the employ of the Commission and others taken from the certified civil service lists:

Mr. A. H. Perkins, Division Engineer, has direct charge of all surveys and other field work. His headquarters is at Albany.

Mr. Russell Suter, Assistant Engineer, is in charge of the surveys on the Black river.

Mr. A. H. Higley, Assistant Engineer, is in charge of surveys on the Genesee river and the construction work for the Canaseraga creek improvement.

Mr. B. F. Vandervoort, Assistant Engineer, is in charge of the power surveys on the Hudson and Genesee rivers.

Mr. E. H. Sargent, Assistant Engineer, is in charge of the drafting room corps in the headquarters office.

The parties under the direction of these Assistant Engineers have been appointed from the lists and included one junior assistant engineer, four levelers, four rodmen, five chainmen, one draftsman, three tracers, nine axemen, and four to six laborers, as their services were required. The force on the Black river remained in the field until November 15th. The force on the Canaseraga creek is still employed in field and office work preparatory to the construction of the proposed creek improvement, and the force engaged in making power surveys on the Hudson and Genesee rivers completed the field work on November 12th. With the exception of the Canaseraga creek force, all of the field parties are now in the Albany office working up their field notes for permanent record and plotting the same on maps.

The total amount of money expended during the year by the engineering bureau, exclusive of the Canaseraga creek work, is \$29,305.15, as per vouchers and reports presented from time to time and on file in the Secretary's office.

MUNICIPAL WATER SUPPLIES.

The maps, plans, specifications and estimates filed with applications for water supply, have been examined and reported upon for twenty-five applications, being Nos. 68 to 92 inclusive.

The most of the petitions comtemplated simple plans for securing a source of water supply by a village or town then without any adequate supply, and as they met with little or no objection, there is nothing worthy of mention in connection with them. Attention may be called to several cases as presenting more important matters.

Application No. 70. The Village of Pike. Petition presented February 3, 1910. The Commission held a hearing in the village of Pike at a time when the ground was covered with so much snow it was impossible from an inspection to form a proper judgment as to the adequacy of the water supply from the source proposed to be used, but on the strength of the report made by the engineer employed by the village, and upon the testimony presented at the hearing, the application was granted. When the reservoir was completed in September, it was discovered that the source of supply had practically failed. There was not sufficient water flowing Fortunately, from the so-called springs to fill a one-inch pipe. there was another spring about half a mile distant, which it is believed will supply the deficiency. This case emphasizes the advisability of having long-time records of the flow of a spring before it is adopted as a source of water supply.

Application No. 72. Otisville Water District. Considerable opposition was raised to this application by the Erie railroad and by the Erie Land Improvement Company, both of which have large interests in the district. The petition contemplates a gravity supply from springs in the hills near the village. The opposition to the plan alleged that the supply is inadequate and that the cost of the works will greatly exceed the engineers estimates. However, after taking testimony and hearing arguments by the attorneys in the case, the application was finally granted on November 30, 1910.

Application No. 74. City of Plattsburgh. Petition presented March 24, 1910, for the right to take water from the Mead

brook. This application was pending for several months on account of a question as to the feasibility of the plan proposed by the city, and also on account of the positive evidence of pollution in the water sought to be used. The city of Plattsburgh had, by petition presented January 19, 1907, duly obtained the right to take water from the West brook, which had a larger watershed, and a purer, more abundant and more wholesome supply, but no work was ever done under the application thus granted. The pending application was therefor denied and the city was advised to take water from the West brook in accordance with the petition therefore granted. By this action the city of Plattsburgh has been saved an expenditure of \$50,000 on a water supply which would have proved inadequate and unwholesome.

Application No. 80. Village of Moravia. Presented on July 6, 1910, contemplated securing an additional supply of water from a system of springs which the village had agreed to purchase. village had suffered from an epidemic of typhoid fever in February and March, 1910, and upon an examination being made of the water it was found to be highly contaminated. authorities thereupon arranged with parties owning springs on a hill to the southeast of the village and made their plans for acquring these springs for an additional source of supply. At the time the application was under consideration your engineer visited the village, and upon going to the springs fround that some of the so-called springs were nothing but surface drainage and absolutely unreliable as a source of supply. He found, however, that three out of the set were good flowing springs, furnishing a very desirable supply of water, both as to quantity and quality. found also that the present supply of water is contaminated from surface drainage, and recommendations were made to the village for the proper protection of the water against further contamina-The application was granted upon the village agreeing to carry out the recommendation of the Commission.

Application No. 84. Village of Silver Springs. Petition presented August 12th for the right to take water from driven wells to be sunk near the village. This application contemplated the substitution of a municipal plant for one owned by a private water company, which had proved inadequate and unsatisfactory as to

the quality of the water. Strong objection was raised by the private Water Company to the granting of the application, but the testimony taken and the physical condition of the private Water Company's plant, as observed by the Commission, was such that the petition of the village was granted.

Application No. 91. Petition presented October 28th, by John A. Drew. This application is from an individual who seeks to engage in the business of supplying water taken from driven weils near the village of White Plains, Westchester county. The water supply of the village of White Plains has failed for two successive years, and the Board of Water Commissioners is now unable to secure an adequate supply from the watershed controlled by them. which fact makes the problem of water supply a very serious Mr. Drew, having prospected at his own expense, and discovered what apparently is a supply of wholesome water from underground sources in the flat valley of the Bronx river north of the village of White Plains, then presented his application with a view to entering into a contract with certain villages in the town of Greenburgh and the village of White Plains to supply water in quantities ranging from one million to three million gallons per day. The application has met with objection by certain of the village officers of White Plains.

The most important water supply application claiming the attention of the Commission and your engineer during the year was that of the city of New York, Application No. 67, filed December 16, 1909, for the right to modify or enlarge the plans for the Catskill aqueduct. This application covers in reality that portion of the plans of the Board of Water Supply of New York city, specifically referred to in the original application as being subject to modifications or enlargements after due study had been given to that portion of the proposed work. The plan contemplates the construction of a deep tunnel from the Hill View reservoir through the Borough of Bronx under the Harlem river into Manhattan, from thence down the length of Manhattan Island under the East river into the Borough of Brooklyn. From the terminus of the tunnel in the Borough of Brooklyn, the plan contemplates a system of cast iron pipes under the streets to connect with the existing distributing systems in the Boroughs of Brooklyn and

Queens, and a further extension of the main pipes under the Narrows to the Borough of Richmond on Staten Island, and emptying into a reservoir of 400,000;000 gallons capacity. The estimated cost of this work is \$25,000,000, and the tunnel will be capable of delivering 500,000,000 gallons of water per day. Some opposition was raised to the granting of this application, but upon taking the testimony at a succession of hearings, the opposition proved to be not well founded and of little strength. The application was finally granted on October 26, 1910.

The work proposed under the twenty-five applications received during the year 1910 contemplates the expenditure by the applicants of \$850,000.00, and the plans contemplate furnishing 9,000,000 gallons of water daily to a combined population of 100,000 persons, which is at the average rate of ninety gallons per capita per day. The combined storage capacities of the reservoirs contemplated by the plans amounts to 512,000,000 gallons.

Many of the municipalities in the State have suffered a shortage in their water supply as a result of the extensive drought of the past six months. In some sections of the State the rainfall during the last half of the year has been less than fifty per cent. of the normal amount. The most seriously affected locality is in Westchester county, as described in a subsequent section of this report.

The time will soon come, if in fact it is not already here, when certain districts of the State in which are situated several thickly settled and growing municipalities, must take active steps to provide against a serious water famine. In such localities the formation of a metropolitan water district would insure an adequate water supply and a just distribution of the same and protect the sources of supply against pollution.

The purpose of creating a Metropolitan Water and Sewerage District is to establish a legal organization as a unit for a combination of two or more adjacent incorporated municipalities, in order to make possible the creation of a common water supply system and a sewage disposal system for the entire district. The district as a whole becomes surety for such bonds as may be issued to raise the necessary funds for the construction of the water and sewerage systems. In such a district each individual municipality retains

its corporate identity and upon the completion of the water supply or sewerage system each receives its proportional share of benefit from such system and pays therefor its proportional share of the cost. To each municipality is delivered its share of the water at wholesale, the distribution of which within its limits is under the jurisdiction of its local officers and the interior sewers may be constructed and maintained by the municipality which they serve.

The management of a Metropolitan District is usually put in the hands of a district commission appointed by the Governor of the State, and all construction work is done by this Commission. The Commission has the supervision over the distribution of the water supply, the construction and regulation of trunk sewers and the final disposal of the sewage, and to it each municipality pays its proportion for the water and sewerage service received.

By the Metropolitan plan several municipalities are assured a larger supply of water and a more comprehensive system of sewage disposal at a lower cost than would be possible were each municipality to undertake an independent development. The work being done as a whole and charged to the several municipalities is more economically accomplished and is to the mutual advantage of all municipalities composing the Metropolitan District.

In the experience of other states it has been found advantageous to combine the water supply and sewerage disposal under one Commission, as these two public works are so closely related they should naturally be considered together.

A Metropolitan Water District such as has been described was established by the State of Massachusetts in 1895 to provide a supply of pure and wholesome water for the city of Boston and the adjoining cities and towns, and the work was intrusted to a Metropolitan Water Board. Six years later the board was consolidated with the Metropolitan Sewerage Board, which had theretofore been created for the purpose of providing adequate sewerage facilities for the same district. Other states have instituted the same system as Massachusetts, notably California, where unusual powers are given to the Metropolitan Water Boards.

WESTCHESTER COUNTY WATER SUPPLY.

The exceptionally dry weather of the present year preceded by two successive dry years has emphasized the advisability of some definite immediate action being taken to provide an adequate system of water supply for the municipalities in Westchester county, especially in the southern section adjacent to the city of Greater New York. Improved transportation, and the rapid growth of the city of New York, have given an impetus to the growth in all of that territory, and its population is increasing so rapidly that many of the present water supplies are inadequate to meet the demands in the summer months and others will have been outgrown within five or ten years. This rapid increase in population not only increases the demand for the water but increases the necessity for filtering all of the water taken from surface sources in Westchester county. The growing importance of water supplies for the urban population of Westchester county has been emphasized in the hearings before this Commission upon the applications of the villages of Ossining, White Plains and Crotonon-Hudson and the Harrison water district.

Previous to October of this year press reports began to take note of an impending water famine in several of the cities and villages in the county, especially in Yonkers, Mount Vernon and White Plains, and even as early as August, the largest two private water companies supplying several of the municipalities within the territory were compelled to seek aid of the city of New York in supplying their customers.

On October 7th, the Commission passed a resolution directing an investigation to be made of the situation in Westchester county, and on the 27th the President of the Commission, accompanied by the Consulting Engineer and the Division Engineer, started upon such an inspection trip. During this trip, lasting three days, all of the reservoirs of the local water supplies were inspected and the water works officials interviewed in regard to the

present and future needs of their respective communities. that time all of the towns dependent upon the New York Interurban Water Company, furnishing water to Mount Vernon and Mamaroneck, and the Consolidated Water Company of Suburban New York, furnishing North Tarrytown, Dobbs Ferry, Uniontown, Scarsdale, Ardsley, and Hastings, were using water obtained from the Croton supply of New York city. Yonkers had a storage in its reservoirs sufficient for only fifteen days supply, and was drawing about one-half of its daily supply from this source, and was seeking permission to draw from the Croton aqueduct if the necessity arose. White Plains, although on the verge of a water famine, was disputing as to the proper remedy to be applied and was experimenting in an effort to obtain water out of driven wells on its own properties. The village was then obtaining more than half of its daily supply from the Kensico aqueduct of New York city. The New Rochelle Water Company was in fairly good condition and was increasing its storage capacity for the future by enlarging its reservoir on Troublesome brook. The Port Chester Water Company was in fair condition. Although the supply was becoming short and the officials were curtailing the daily use of water they expected to have sufficient to last through the drought. The source of supply is in Connecticut and the water is received at the State line from the Greenwich (Conn.) Water Company. The latter company is preparing for future needs by raising its dam and increasing the storage capacity of the reservoir. At Tarrytown, the reservoir was about one-half full and appeared to have water enough in storage to last the village through the dry period.

The villages of North Tarrytown, Dobbs Ferry, Hastings and Ardsley, being supplied by the Consolidated Water Company, were obtaining practically all of their supply from the Croton aqueduct. The village of Ossining had sufficient water in storage to carry it over the drought provided care was exercised in the matter of consumption. The village of Peekskill was amply supplied and entertained no fear of a famine. However, the water department urged upon the citizens the greatest care to prevent waste and unnecessary use of water.

This inspection showed conclusively that all of the present supplies were being taxed to their limit, and in several most important

cases had been practically exhausted, and that some private companies and towns were energetically preparing to provide for future demands while others were depending more or less upon the good will of New York city in sharing its water supply to tide them over the driest seasons.

To remedy the conditions both temporarily and for the future, various suggestions are being put forward in each town, the more important of which are:

(a) Annexation to New York City.

(b) Further development of local sources.

(c) The development of underground sources.

(d) Purchase of water from the city of New York when the Catskill supply becomes available, which will be possible under chapter 724 of the Laws of 1905.

(e) The formation of a Metropolitan Water District to obtain

water from some source outside of the county.

(f) The incorporation of a new city consolidating the municipalities in the southern part of the county.

As an instance of projects for the further development of present supplies may be mentioned the proposition of the Consolidated Water Company presented to the city of Yonkers, offering to sell to that city its Pocantico supply. This company proposed to sell to the city of Yonkers for \$1,600,000 its plant, which now supplies North Tarrytown, Dobbs Ferry, Hastings, Uniontown, Scarsdale and Ardsley. The company claim that the entire flow of the stream can be stored on the Pocantico watershed, thus giving a low water supply of 12,000,000 gallons per day, but suggested a plan to construct an aqueduct from the watershed to the Grassy Sprain reservoir for storage in the city of Yonkers, and it estimated the cost of the project, including the purchase of the company's rights, at \$3,000,000. The company estimated the cost of water delivered in the Grassy Sprain reservoir by this aqueduct at \$40 per million gallons. The aqueduct would have to be from eight and one-half miles to nine and one-half miles long to reach the Grassy Sprain basin at the required elevation. All water taken from this reservoir has to be pumped into the city mains. total supply available under these proposed conditions was estimated at 8,000,000 gallons per day.

Assuming the estimate of the water company to be correct, viz., \$3,000,000 for the total cost of the work, and computing interest at 4½ per cent., depreciation, repairs, operation and sinking fund at 2½ per cent., the cost to the city of Yonkers of this water delivered to the Grassy Sprain reservoir would be \$71.92 per million gallons, and to this price must be added the cost of pumping into the city distributing system.

In the annual report of the bureau of water of the city of Yonkers for 1909, the average operative cost of pumping for all of the water measured by plunger displacement is given as \$18.60 per million gallons. With interest, depreciation and sinking fund allowance at 6 per cent. on the cost of the pumping plant under conditions existing at Yonkers, the total average pumping cost of this water is \$25.39 per million gallons, which if added to the estimated cost of water from the proposed Pocantico source makes a gross cost of \$97.31 per million gallons. Ultimately considerable additional costs will arise from the protection of the supply from contamination or for filtration at an added cost of about \$12 per million gallons. While sales of water to towns now supplied by the Pocantico system might possibly reduce this somewhat (provided the city of Yonkers continued to furnish water to those localities), and might bring the cost down to \$90 or \$100 per million gallons as an average for high and low service in that city, doubtless this figure would be considerably exceeded.

This case has been set forth thus fully as a fair example of the probable cost of an adequate additional supply from local sources for any of the towns of Westchester county. The water supplied to the cities, villages and private water companies by the city of New York is being paid for at the rate of \$133.33 per million gallons, and in addition to this the municipalities and water companies obtaining the water are put to the further expense of pumping into their respective distribution systems and of maintenance.

As an instance of water supply development from underground sources, the situation at White Plains may be cited. In this instance a contract has been entered into by the board of water commissioners with an individual, who at his own expense prospected for and found a good underground supply near the village. The contract contemplates a supply of not less than 1,000,000 gallons

daily, derived from driven wells, to be furnished to the village under pressure at \$80 per million gallons.

While the city of New York is now furnishing municipalities and water companies in distress at the same rate which is charged smaller consumers in the city, it is doing so purely as a matter of neighborly consideration. There is no legal obligation upon the city to sell its water until the new Catskill aqueduct is completed, at which time any municipality may purchase its supply from the city of New York, but must pay therefor at the same rate as may be charged the citizens of New York City. In the present situation should a question arise as to the sufficiency of New York's supply in storage, or a legal question be raised by some citizen bringing injunction proceedings, it is possible that New York City would be permanently restrained from any further sale of water previous to the completion of the Catskill aqueduct. In fact, New York City is almost certain to require all of her Croton and Kensico supplies for her own use before the Catskill supply becomes available, and doubtless before running any risk of the possibility of a shortage in her own territory, she will cut off the supply now being allowed to neighboring municipalities.

To illustrate the conditions of rainfall during the past few years in Westchester county, and the increase in population and consumption of water, three tables are submitted herewith.

Table I shows the rainfall at points in Westchester county and New York City for the years 1907 to 1910, inclusive. These records show that the rainfall for the year 1908 at the four stations was 14.8 per cent. less than the long term average for the same stations. For 1909 it was 5.0 per cent. less than the average. For the first nine months of 1910 the rainfall has been 28 per cent. less than the long term average for the same nine months at the same stations. It is thus seen that the present year has been a record-breaking one in the matter of dryness in Westchester county, and having been preceded by two more than ordinarily dry years, the severity of the existing water famine is not to be wondered at.

TABLE I.

Rainfall Records for Westchester County and Vicinity.

		RAINF	ALL IN INCE	Es.	
STATION.	1907.	1908.	1909.	1910.	Long term average.
Croton watershed	57.30 50.61 45.28 55.64	42.26 39.53 41.43 40.63	51.54 42.06 41.55 47.69	44 .14 35 .36 35 .98 84 .83	49.04 48.08 44.63 50.68
Mean	52.21	40.96	45.71	37.58	48.11
Departure from long term	+4.10 +8.5%	-7.15 -14.8%	-2.40 -5.0%	-10.53 -21.9%	

Table II shows the monthly rainfall and departures from the long term records for the year 1910 at the same observation stations as are given in Table I.

TABLE II.

Monthly Rainfall Records in Westchester County and Vicinity (1910).

MONTH.	Cro Wate	TON RSHED.	Вког	ORD.	New Cr		Mount	Норв.
	Rainfall.	Dept'r.	Rainfall.	Dept'r.	Rainfall.	Dept'r.	Rainfall.	Dept'r.
January February March April May June July August September October November December	7.20 5.70 0.78 6.59 3.37 5.35 1.23 2.69 1.98 1.62 4.84 2.79	+3.08 +1.59 -3.46 +3.11 -0.48 +1.77 -3.47 -2.31 -2.26 -2.36 +1.05 -1.16	4.32 3.15 0.40 5.20 3.35 3.42 1.48 2.44 2.06 2.34 5.08 2.12	+0.68 -0.93 -3.24 +1.75 -1.21 -0.13 -3.08 -2.67 -2.11 -1.60 +1.42 -1.60	5.61 4.07 0.86 4.53 1.66 5.10 0.23 2.13 1.43 3.79 4.62 1.95	+1.82 +0.83 -3.24 +1.23 -1.52 +1.84 -4.31 -2.16 +0.08 +1.18 -1.50	3.20 2.85 1.22 6.05 4.11 5.90 0.79 1.63 2.10 1.25 *3.58 *2.15	-0.63 -0.89 -3.09 +1.97 -0.39 +1.97 -4.71 -3.68 -1.84 -3.46 +0.61
Total	44.14	-4.90	35.36	12.72	35.98	8.65	34.83	-15.85

[&]quot;Dept'r." indicates departure from long term monthly averages.

* Scarsdale records, Mt. Hope record not available.

A study of the rainfall map of New York State submitted herewith, indicates that the area from which the present water supplies for Westchester county are being obtained will yield almost as much water per square mile as the Croton watershed, and in our computation it has been assumed that the yield per square mile will be the same as the Croton yield under the same development of storage reservoirs.

Table III shows the population of the various municipalities in Westchester county using water, the ownership of the water supply, the source of supply, whether filtered or not, and the rates charged for water per million gallons.

TABLE III.

		Popul	ATION.			lates Per Gallons.	works by mu-	ğ.
MUNICIPALITY.	1900.	1905.	1910.	Change in five years.	Maxi- mum.	Mini- mum.	Water owned nicipalit	Water filtered.
Cities. Mt. Vernon New Rochelle Yonkers	21,228 14,720 47,931	25,006 20,479 61,716	30,919 28,867 79,803	23.6 40.8 29.3	\$300 00 285 00 150 00	\$100 00 200 00 60 00	No No Yes	Yes. No. Yes.
Total Villages (Incor.)	83,879	107,201	139,589	30.2	200 00	100.00	No	Yes.
Ardsley	404 e350 579 2,888 2,002 2,231	470 417 994 3,515 3,060 2,480	537 950 1,863 3,455 4,552 2,319	14.3 128.0 87.5 —1.7 48.8 —6.5	300 00 267 38 300 00 300 00 300 00 400 00	100 00 213 90 100 00 100 00 100 00 300 00	No Yes No No No Yes	Yes. Yes. No. No.
Larchmont	945 4,722 4,241 7,939 303	1,760 5,090 4,750 7,135 349	1,958 5,699 5,421 11,480 681	11.3 12.0 14.1 60.9 95.2	300 00 300 00 200 00 300 00	100 00 100 00 120 00 100 00	No No No Yes No	Yes. Yes. No. No.
Pelham Manor Pleasantville Port Chester Rye Tarrytown	e575 1,204 7,440 3,000 4,770	638 1,585 11,198 4,076 5,370	852 2,207 12,809 3,964 5,600	33.6 39.2 14.5 —2.8 4.8	285 00 533 33 293 33 293 33 400 00	200 00 200 00 161 33 161 33 93 33	No Yes No No Yes	No. Yes. Yes. Yes.
Tuckahoe White Plains Total	61,000 7,899 52,492	1,580 11,579 66,046	2,722 15,949 83,018	72.4 37.8 25.6	300 00 300 00	100 00 100 00	No Yes	No.
Grand total	136,371	173,247	222,607	28.5				

NOTE.— There is a population estimated at 7,000, not included in the cities and villages in the territory which is now supplied with water from a public supply.

It is estimated that the total number of inhabitants of the district requiring water service in 1915 will be 300,000; 395,000 in 1920 and 525,000 in 1925.

"e;" estimated.

The requirements as to consumption of water by the present population may reasonably be taken at an average of 100 gallons per inhabitant per day. In some municipalities the consumption is more than this average and in some it is less, but this figure is assumed as a fair average for such municipalities as those under consideration. As the population grows, however, the consumption per capita will probably increase and in a few years will reach at least 120 gallons per inhabitant per day. The exceptionally fine opportunities for shipping facilities and manufacturing plants along the shore of the Hudson river and Long Island sound will undoubtedly be recognized by manufacturers, and in the near future large demands for water for manufacturing purposes will have to be met. It is probable also that the present high prices paid for water in the greater part of this district will have to be adjusted and reduced. Some of the contributing causes to the present high prices are:

- 1. Suburban character of the towns and the consequent length of distributing mains per inhabitant served.
- 2. The high value of the lands purchased for additional storage capacity or the protection of the purity of the water supply. In one instance \$2,500 per acre has been paid recently for such land.
- 3. The necessity for sufficient income to pay attractive dividends to the stockholders in private water companies.
- 4. The multiplicity of small plants, each with its independent management and operating force and expense.
- 5. The necessity for pumping and filtering practically all of the supplies.

It is probable that with a comprehensive plan carefully executed, a very considerable reduction in the selling price of water could be effected which would undoubtedly result in increased consumption, so that in any event any comprehensive plan to be adopted for the supply of the municipalities in Westchester county should provide for a consumption of not less than 120 gallons per inhabitant per day.

A further table is submitted (Table IV), showing the various sources of supply, drainage areas, the capacity of the reservoirs, the storage per square mile of the drainage area, the municipality or places where the water is consumed, the population served, the present yield, capacity of proposed storage, etc. The nearest and most practical sources of additional water supply are also included.

TABLE IV. Westchester County Water Supplies.

Æ	Present Storage.			id per	Proposed Storage	Storage.		olle.	
Capacity mil. gal. Per. sq. mile mil. cu. ft.		Owner.	Where used.	Present yle 24 hrs. mil	Reservoir.	Drainage ones aq. ml.	Capacity mil. gal. Total stor	Utimate yie gal. per 26	
1,000	Port Chester Co	Water	Port Chester. Greenwich, Conn.	1.8				1.3	In Connecticut in- crease possible.
					Purchase Port Chester	6000		*1.8	Not utilized.
	N. Y. In Wate	Y. Interurban Water Co.	Mt. Vernon and Mamaroneck	8.9. 8.0.	Res. "A". Res. "B" East Branch	11.0 (melude 2.8	600 400 d in "B")	8.8 8.5	White Plains application.
2 2 Res., 4.3	arehmon	t Water Co.	4.3 Larehmont Water Co. Larehmont	=				2.0	
1	N. Y. Int Wate	Y. Interurban Water Co.	Mt. Vernon	6.0				6.0	
271. 125. 10.0	N. Y. I. W. Co	\$: :	New Rochelle	2.7				2.7	
8	White Pla	White Plains	White Plains	See welk	Fair Ground	3.4			"Fair Ground" not considered potable water.
220	New Roe Co	New Rochelle Water	New Rochelle	1.1					

Grassy Sprain Grassy Sprian	Grassy Sprian	4.8	g		Gity of Youbers City of Youbers	Olty of Yonkers	4.8				_	4.5
								Lower Sprain	1.4		_	0.10
Sawmill river	Stony Brook	1.3	250	:	Tarrytown Youkers	Tarrytown Yonkers	0.0					1.0 Not potable water unless filtered.
Pocantico river Pocantico	Pocantico	0.21	88		Consolidated Water Co. of Suburban N. Y.	N. Tarrytown	2.0	2.0 Posntiso	12.0	98	88 88	3.5 L. W. Bow 400,000
						Dobbs Ferry Hastings. Ardaley						To be to more
Indian brook	Indian brook Intermediate	. .	130 17		Ossining	Oweining	1.2				:	1.2
Peekukill creek			8		Peekskill	Peekskill						Not included in proposed district.
Wells		% - 45			White Plains Youkers	White Plains	1.1	Kensico wells		2.0		1.1
		3 ·			Co. Briareliff Manor	New Rochelle Briarcliff Manor.	0.1	1.5 New wells	1.0		:	2.5
					Total present supply		23.5					41.9 Total practicable local supply.
Peekskill greek							:	Oscawana L. Wickopee, 1 Wickopee, 2 Barger Pond Mohigan L.		4884H		22.4 2.3.7.6.0 1.8.7.6.0
Popolopen creek								Popolopen Queenaboro Br., No. 1 Queenaboro Br., No. 2 Queenaboro Br., No. 3	16.0			16.0 2.2 1.9
								Lower Popolopen	900			8.00

* Assumed.
Nors. —In the light of the experience of the last three years all yields are probably less than those here given.

While the table of population (Table III) is not as complete as desirable, it indicates that in 1915 a population of 300,000 will have to be provided for. With a consumption of 120 gallons per inhabitant per day, 36,000,000 gallons per day must be provided.

The table of water supplies (Table IV) shows a present low water supply of about 22,500,000 gallons per day. Additional possibilities show a possible increase from local supplies of 19,500,000 gallons per day. Thus if all local supplies considered practicable are developed, 1917 or 1918 will see them all exhausted. We believe we have overestimated local possibilities rather than otherwise.

We are aware that we have left out of consideration some sources that may be considered practicable by others. Conspicuous among these will appear the Sawmill river. The large population on this stream, its sluggish character, and the absence of cheap reservoir sites are all unfavorable to the economical development of this stream as a source of supply of potable water. With the pumping, filtering, high cost of reservoirs and cost of protection and inspection, all contributing to the cost of water supply from this stream, we believe that cheaper supplies may be obtained from more distant sources.

More DISTANT AND EXTERIOR SOURCES.

In considering more distant sources of water supply or those exterior to Westchester county, the following facts must not be lost sight of:

- 1. Before exterior supplies can even with the greatest diligence be made available to the inhabitants of Westchester county, local supplies will have become inadequate.
- 2. That water from exterior sources can be delivered by gravity under sufficient pressure to preclude the necessity of pumping, and probably under conditions precluding for some time at least the necessity for filtering, and at a cost but little, if any, in excess of the present cost for pumping and filtering.

To secure necessary legislation, make the necessary surveys, maps, plans, specifications and estimates and to secure proper discussion and approval will require from one to two years or more, and to secure the necessary lands and rights, and to construct the works probably three years more.

In support of the belief that water can be furnished under the required pressure, at a price but little in excess of the present cost of pumping and filtering, we offer the example of Yonkers stated previously, and we venture to say that the cost there stated for the service rendered will compare favorably with the cost of similar service anywhere in the proposed district when all items are taken into consideration.

Reference may also be made to the report of the Commission on additional water supply for the city of New York made in 1903, page 53 et seq. That Commission investigated the cost of pumping New York city supplies. In the borough of Manhattan, after tests and repairs had been begun, the average cost per million gallons pumped was \$0.0627 per foot of elevation. It is assumed that this includes interest and sinking fund charges. ough of Queens, a small plant, the cost was \$0.24 per million gallons per foot of elevation without any allowance for interest, depreciation or sinking fund. The Commission stated that although the unit cost of pumping in small stations must always greatly exceed that in large stations, the cost at this station is still unnecessarily large. In the borough of Brooklyn pumping from driven wells with 30-foot lift, the cost is \$0.27 per million gallons raised At Milburn, with 50-foot lift, the cost is \$0.065, at Ridgewood the cost is said to be about \$0.05, at Mount Prospect the cost is \$0.11. The Commission estimated that for the 30-foot lift from the wells the cost could be reduced to \$0.085 per million gallons per foot of elevation by the introduction of electric motors supplied with current from a central station.

For the small isolated plant the cost of pumping cannot be assumed at less than \$0.10 per million gallons per foot of elevation under average conditions, and it probably exceeds this figure considerably. Assuming a head of 300 feet as the average against which the water must be pumped in the Westchester county municipalities, this cost alone is \$30 per million gallons.

For filtration, the estimated cost of operation given in the same report ("Burr-Herring-Freeman report") for a 250,000,000 daily capacity plant is \$8.40 per million gallons and for a 500,000,000 daily capacity plant, \$8.10. It is probable that the cost of slow sand filtration for small capacity plants under ordinary

management and conditions existing in Westchester county is not less than \$12 per million gallons when all proper charges are included.

The cost of pumping and filtering present supplies in Westchester county is probably in excess of \$42 per million gallons.

Proceeding now to available more distant or exterior supplies, we have listed two sources, which from the very limited study we have been able to give this branch of the subject appear especially suitable. These are Popolopen creek and its tributaries on the west side of the Hudson river, and some tributaries of Peekskill creek on the east side.

Popolopen creek was considered by Mr. Freeman in 1900 in his report upon New York's water supply, etc., made to Bird S. Coler, comptroller, p. 502. He thought it "a very favorable watershed of its size but too small except as an adjunct to some larger source. The conditions affecting the quality of the water appear most favorable and this promises to be a supply of exceptional purity." He estimated the cost of the reservoirs for storage at \$2,422,000. The U.S.G. S. topographic maps covering this territory have become available since Mr. Freeman's report was made. We learn from a study of these maps that the water from an area of nearly twenty square miles could be impounded in a single reservoir of sufficient capacity to control the entire flow, and at an elevation of over 600 feet above sea level. The water from 10 square miles of the area of Queensboro Brook basin could be delivered at elevation 500, and that from 5.6 square miles of the upper areas of the watershed (Queensboro brook (4.1 square miles), and Cedar Pond brook (1.5 square miles) could be delivered at elevation 600. unlimited pondages available a yield of one million gallons per square mile per day should be economically secured, or about 25.6 million gallons per day at elevation 600. At elevation 400, about 35 million gallons per day would be available. The watershed of Popolopen creek appears in every way admirably adapted as a collecting ground for water supplies. If it should be used, and completely developed, further supplies can be obtained from various sources in the mountainous district near Peekskill.

There is a particularly promising possibility in the Peekskill

Creek watershed at Oscawana lake and vicinity, where it appears possible to use the lake as a reservoir for about ten square miles of area by turning into it the drainage from the two creeks lying to the north in the vicinity of Wickopee. The storage available appears to be ample to fully control the flow so that a further supply of 10,000,000 gallons per day at elevation 550 should be available. The further possibilities of this region are very great.

These supplies at elevation 550 or over, amounting to 35,000,000 gallons per day, should be sufficient to last until 1925 when taken in connection with local supplies fully developed. As to their cost, we hesitate at giving an estimate with so little data on which to found our judgment, but if it be understood that it is an approximate estimate only we hazard the figure of \$7,500,000, or \$41.10 per million gallons reckoning interest at 4½ per cent., depreciation, sinking fund and repairs at 2 per cent., and operation at \$37,500 per annum. We have estimated that these supplies could be delivered at an elevation of about 400 feet above sea level.

The time at our disposal for the investigation of this subject has been too short to collect the facts as fully and carefully as the importance of the subject deserves. It is clear, however, that the situation in Westchester county is extremely serious and is only saved from being desperate by the good nature and humanity of the New York City officials. How long this good nature may be depended upon or how long New York City will be permitted to share its water supply is a problem for the solution of which the people of Westchester county cannot afford to wait.

It is clear, therefore, that:

- 1. There should be immediate and concerted action on the part of the Westchester county municipalities to secure temporary relief, and
- 2. There should be immediate and concerted action to secure adequate future supplies. To this end private water companies operating in this territory should be compelled to develop their territory to the extent necessary to furnish to their customers the ample supplies called for by their charters, and in case this does not completely utilize all the water furnished by the watersheds on which their works are located, then storage of flood waters by other companies or municipalities must be permitted.

- 3. The various municipalities and water companies must be united through some agency to secure concerted action.
- 4. The questions of methods and policies to be pursued must be settled as soon as possible.

For the reasons which have been set forth above, the enactment of a law or laws is recommended as follows:

- 1. Providing for the creation of a metropolitan water and sew erage district composed of all that part of Westchester county lying south of the towns of New Castle and North Castle, subject to confirmation by a vote of the inhabitants thereof and conferring upon the State Water Supply Commission power for the distribution of local sources of water supply and directing their development. In such a metropolitan district the individual municipalities will not lose their identity.
- 2. Providing for a special election at which the following questions shall be submitted to the voters of said metropolitan water and sewerage district:
- (a) Shall the territory comprising said district be formed into a metropolitan water and sewerage district, and in the event that question "a" is decided in the affirmative, then
- (b) Shall the said district spend, under the direction of the State Water Supply Commission, \$50,000 in making surveys and preparing maps, plans, specifications and estimates for additional water supplies, said maps, plans, specifications and estimates, together with a law making an appropriation for construction and fixing the method of distribution of costs, to be submitted to a further vote for approval before construction is authorized.

RIVER IMPROVEMENT.

Canaseraga Creek. At the close of the year, 1909, the resurvey of the Canascraga Improvement District had been completed. together with the maps and descriptions of the numerous parcels composing the district, and surveys for the establishment of a boundary line of the improvement district. Upon the completion of the maps and descriptions of the improvement district, the same were filed in the office of the clerk of Livingston county, on January 12, 1910, and pursuant to due notice thereof being given, six hearings were held in Geneseo and in the village of Mount Morris between February 9th and April 15th, at which all persons interested were given an opportunity to be heard either for or against the establishment of the proposed boundaries and extent of the district. Final action was taxen by the Commission on April 15th, establishing the boundaries of the improvement district, as shown on the map filed, and upon which the hearings had been held. Shortly after this proceeding was had, the bonds for the improvement district were offered for sale, and on July 1st a satisfactory bid was received, resulting in the sale of \$200,000 worth of bonds at a premium. Some little delay followed the acceptance of the bid for the bonds, while the attorneys for the purchaser examined into the legality and security of the bonds. On September 12, 1910, the proceeds from the bond sale being in hand, the necessary supplemental contract with DeWitt C. Stephens, assignee of the firm of Graves & Stephens, was executed by the Commission and the contractor, and orders were given him to proceed immediately with the construction of the proposed improvement. On the 10th of September an engineering party was sent to the Canaseraga creek, with headquarters at Dansville, and surveys started for the final location of the cut-offs and for the necessary rights of way for the improvement of the creek. At this date, the main creek and the proposed cut-offs have been cross-sectioned, and working estimates prepared over the entire length of the proposed improvement. Right of way maps and descriptions have been prepared covering practically all of the work to be done between North Dansville and the Groveland road, including the State and west ditches and Bradner creek.

Upon written request of the contractor, permission has been granted him to sublet the dredging on the main creek and cut-

offs, and certain other items in his contract relating to the construction of bridges, pile driving and timber crib work. The subcontracts have been let to two parties in the hope that the work would thereby be expedited and that actual construction work might be started before the winter season. The Brookville Bridge Company, Brookville, Ohio, has the bridge and concrete subcontract and Forestal & Downing, Milwaukee, have the dredging. At this date the contractor has one dredge on the ground and is erecting it to begin work on the main creek channel immediately north of the Dansville and Mt. Morris railroad bridge.

Genesee River Improvement.— The maps, plans, lists, specifications and other papers required under section 12 of the State Boards and Commissions Law have been prepared for filing, in the matter of the application of the supervisors of the county of Monroe for the regulation of the Genesee river under the River Improvement act and were approved by you on December 1, 1910. The basis upon which these maps, plans, and lists have been prepared is the construction of a high masonry dam on the Genesee river at the "Rafter site" above the upper Portage Falls, which will form the socalled Portage reservoir, and impound 13,000,000,000 cubic feet of water to elevation 1,198, and provide for an additional storage of 6,000,000,000 cubic feet for flood control, with a flood flow line at elevation 1,215. properties below the dam which in the judgment of your engineer, will receive a benefit from this improvement, includes the farm lands in the bottom of the gorge between Portage and Mount Morris, the lands in the Canaseraga valley south of the Erie Railroad, which lie below elevation 570, and all of the lands in the valley of the Genesee between Mount Morris and the Upper Falls in the city of Rochester which have been heretofore subject to damage by the floods which occur almost annually in the river. The maps, plans, etc., prepared in this connection are as follows:

1. A general map of the Genesee river from Lake Ontario to the south end of the proposed Portage reservoir in the town of Canadea, Allegany county. The map shows the location of the Genesee river, the territory to be included in the Portage reservoir, the territory subject to floods between the falls in the city of Rochester, and the falls at Portage, including the portion of the Canaseraga creek valley which is affected by the Genesee river

- floods. The map also shows the several boundary lines between counties and towns, the location of the city of Rochester and the several villages situated in the vicinity of the river.
- 2. A set of maps covering the entire territory to be included in the Portage reservoir behind a dam constructed on the so-called Rafter site above the upper Portage Falls. These maps show in detail every farm in the territory, the village lots, the right-of-way of the Pennsylvania railroad, the highways, buildings, and the topographic details.
- 3. A set of plans of the Portage dam, including a plan, elevation and cross sections of the dam and spillway.
- 4. A map and profile of the proposed relocation of the Pennsylvania Railroad.
- 5. A map of the Portage reservoir and vicinity showing the proposed changes in the location of highway affected by the improvement.

The papers and lists prepared in this matter are as follows:

- 1. A list of the counties, towns, cities and villages to be benefited by the proposed improvement.
- 2. A list of the railroads, corporations and individual property owners in the valley of the Genesee and Canaseraga creek below Portage whose lands will be benefited by the proposed improvement.
- 3. A general specification of the proposed improvement in sufficient detail to briefly but clearly explain the maps and plans and the nature and details of the proposed improvement. These specifications do not necessarily go into the details of specifying the materials which will enter into the construction of the Portage dam, the change of the Pennsylvania Railroad, etc., nor are they such specifications as would be required for a contract, but they are in sufficient detail to afford a clear understanding of the nature and extent of the proposed improvement.
- 4. A detailed estimate of the cost of the proposed improvement including the cost of the Portage dam and spillway with their appurtenances; the cost of land to be acquired for the reservoir, and the change of highways and the Pennsylvania Railroad; the cost of reconstructing the highways, including the bridges; the cost of reconstructing the Pennsylvania Railroad, including bridges and completed track, and all other expense incidental to the execution of the plans.

5. A report and tentative plan for the apportionment of the cost of the improvement upon the counties, towns, cities, villages and individuals receiving a benefit therefrom.

The above-mentioned maps, plans and papers were filed in the offices of the County Clerks of Monroe, Livingston, Allegany and Wyoming counties, on December 15th and 16th, 1910, and a date set for a hearing in the matter at Rochester on February 2nd, 1911.

Your Engineer still believes, as pointed out in his previous reports that the regulation of the Genesee river for the protection of the public health and safety alone, by the construction of the Portage reservoir, is not a feasible or practical plan, for the reason that the high cost of such a reservoir is greater than the value of the lands and other properties benefited will warrant when protection from flood damage alone is considered. In his judgment, the only feasible and economical basis upon which the Portage reservoir can be built, is that of combined flood control and power and with a power development made at Portage. However, he fully realizes the situation urged upon the Commission by the parties interested in having proceedings taken under the River Improvement act for the proposed Genesee river improvement and believes that by taking such proceedings the whole matter in all its phases will be officially considered and advanced.

Hudson River Improvement.

Petitions for the regulation of the Hudson river and its tributaries under the River Improvement Act, were filed with the Commission on the 17th day of December, 1909, such petitions being from the following:— (1) The City of Albany; (2) the town of Queensbury, county of Warren, in which town Glens Falls is situated; (3) the employees of the West Virginia Pulp & Paper Company at Mechanicville, Saratoga county; (4) the residents and business men of Mechanicville; (5) The International Paper Co., the Union Bag & Paper Co., The Iroquois Pulp & Paper Co., West Virginia Pulp & Paper Co., Hudson River Power Co., the Hudson Valley R. R. Co., and the Finch & Pruyn Company, all praying for the same relief from the irregular flow of the Hudson river and the damage caused thereby.

These petitions were held under consideration from the date of their presentation until the 17th day of November, 1910, when the Commission, after hearing arguments by the petitioners, duly determined that the relief prayed for should be granted, and directed your engineer to prepare the necessary preliminary maps, plans, surveys, estimates, lists, etc., as required by the River Improvement law.

The surveys, maps and plans which have been made in connection with the water power and water storage investigations during the past three years are all applicable to the consideration of the improvement of the Hudson river, but they are far from being adequate for a full study of the matter as they cover only a small portion of the data which will be necessary before a comprehensive plan can be prepared for the regulation of the river. The reservoirs proposed in the reports on the investigations for water storage, will control only about one-fifth of the total watershed of the Hudson river above Troy. No complete surveys have been made along the shores of the Hudson river below Hadley for the purpose of locating cities, towns, villages and individual property, and manufacturing plants which are damaged by the unregulated flow of the Hudson river and are to be benefited by the proposed improvement, nor have any surveys been made below the city of Albany to determine the causes for the formation of ice gorges, which is one of the important elements in the consideration of the flood damage between the cities of Troy and Hudson.

Studies are being made and data collected and maps prepared in the matter of the Hudson river regulation in compliance with your directions.

Raquette River Improvement.

In the matter of the application of the Board of Trustees of the village of Tupper Lake,, in which case a petition was presented on July 19, 1909, contemplating the construction of a dam at Setting Pole Rapids in the Raquette river for the purpose of controlling the level of water in Raquette pond, no material progress has been made during the year except that the people behind the project represented by Mr. James L. Jacobs of the Tupper Lake Board of Trade, succeeded in arriving at tentative agreement with Mr. Edward H. Litchfield, for a modification of the injunction obtained by him several years ago prohibiting raising the dam at

Setting Pole Rapids and flooding his lands on the shores of Tupper lake and Raquette pond. A draft of the proposed stipulation for the modification of the Litchfield injunction was submitted to the Commission for its consideration on July 16, 1910. The matter being submitted to your engineer for his report was returned to Tupper lake with suggestions as to its modification and additional provisions, which in our judgment should be incorporated in the stipulation in order to make the plan more feasible. Nothing has developed since that date, and we are without further information as to the success of the village of Tupper Lake in raising the necessary funds for the construction of the dam.

WATER STORAGE AND WATER POWER.

In conformity with a tentative plan of the work of the Engineering Bureau for the season of 1910, submitted by your Consulting engineer under date of April 11, 1910, it was directed that the energies and attention of the bureau should be devoted to the following:

- (a) Making a study of the power and storage possibilities on the Oswego-Seneca rivers with their tributaries, including the Finger lakes.
- (b) Surveys of reservoir sites on the Black river at the points referred to in the reconnaissance reports of 1909.
- (c) A complete power survey on the Hudson river from Hadley to Troy.
- (d) A power survey on the Genesee river at Mount Morris and Rochester.
- (e) Continuation of the hydrographic studies, including the maintenance of the stream gaging and rainfall observation stations heretofore established and the establishment of such additional stations as should be from time to time decided necessary.

As soon as the money from the appropriation for these purposes was available, field and office parties were organized and the work undertaken as rapidly as men qualified for the work could be secured from the civil service lists.

OSWEGO RIVER.

In the fourth annual report it was pointed out that owing to the fact that about one tenth of the drainage area of the Oswego river

is water surface and swamp the river has a flow naturally regulated to a greater extent than any other stream in the state, and that it is also naturally endowed with storage possibilities for further regulation. These natural possibilities have, however, been rendered impracticable to a great extent by the location of cities and towns on the shores of the lakes down to the water's edge and by the use of the lakes for navigation. These artificial obstacles in the way of regulation have grown to such importance that taken in connection with the comparatively low heads available on the Osewgo river proper, it is not practicable to take advantage of the natural storage possibilities except within very narrow limits. Within these narrow limits considerable results may be achieved at remarkably low cost when taken in connection with the barge canal construction.

During the year office studies have been made and data collected on the Oswego river by Mr. A. H. Perkins, Division Engineer, and several reconnaissance trips have been made to study the storage possibilities on certain of the finger lakes. Access has been had to the Barge canal plans which have been studied so far as they relate to this river.

Table V shows in condensed form the amount of practicable storage on the various lakes in the Oswego river basin and shows the elevation between which the lake surfaces will fluctuate, as proposed by the present Barge canal. The table shows also what storage is considered practicable in addition to that contemplated by the Barge canal plans, and the power benefits to be derived from storage alone aggregating 12,188 horsepower years; which means that the stored water alone when used under the heads available below the several storage basins would be sufficient to develop 12,188 horsepower continuously twenty-four hours per day for each day in every year. That would be ideal regulation, but of course the water can not be used in this way but must be used in conjunction with the naturally low water flow during the dry period of each year at a rate two or three times as great as if used continuously and upon wheels which would otherwise be idle. The power owners on the stream will not be required to make any further expenditures for plant to take advantage of the possible power from the stored water.

TABLE V.

Practical Storage on the Finger Lakes, Oswego River Basin.

					Pressi	PRESENT PLANS OF BARGE CANAL.	P BARGE	CANAL.		Proposed	PROPOSED BY STATE WATER SUPPLY COMMISSION.	E WATER	WITHIN THE WATER-	N THE WATER-
LAKE.	age are.	water water surface.	Notes.	Maximum eleva- tion to be per- mitted.	Lowest winter stage.	Highest naviga- tion stage.	Lowest naviga- tion stage.	Storage for summer regula- tion.	Storage for winter regrila- tion.	Maximum water surface.	Mini- mum navign- tion.	Storage pos- mble.	Avail- able fall below. storage.	Power from total storage.
	Sq. miles Sq. miles.	Sq. miles.		Elev.	Eler.	Mer.	Eler.	Billion Ct. ft.	Billion cu. ft.	Eler.	Eler.	Billion cu. ft.	Pref.	H. P.
Cherata.		R	for power.	1374.4	*360.4	369.4	300.4	0.00	0.000	874.4	4369.4	11.00	011	3,490
Skenes teles Owasco Cayuga Seneca	2882	21.21.28.28.28.28.28.28.28.28.28.28.28.28.28.	Syracuse water supply source Used at present for storage for Frie Canal To be controlled by Barre Canal To be controlled by Barre Canal	287.0 387.0 440.0	280.0 280.0 444.5	1708.4 •384.0	704.9 381.5 445.0	41.210 4.656 3.680	0.000 a.931	715.0 384.0 447.0	50.5 20.5 20.5	3.46	5.23 5.23 5.23 5.23 5.23 5.23 5.23 5.2	:
Neuka Onondaga Canandaigus		4.81		1.7891	1682.0	1685.2		11.000		0.780	0.789	2.00	8	1.673
Total added	power, ho	rae-power-	Total added power, horse-power-years.											12,188

q The lake could be further drawn to elev. 366.4 for winter use, giving 6 bill, cu. ft. ‡ Flood stage temporary only. on of spillway crest. to the natural regulation of the Oswego, storage is very rarely useful after the middle of December.

A very happy mean was apparently reached in the cases of Cayuga and Seneca lakes, through a hearing on the subject of the proposed lake levels, held on August 4, 1910, by the canal Advisory board of consulting engineers, and thereby a long standing antagonism between the water power owners on the Oswego river and the people of the cities of Ithaca, Watkins and Geneva seems in a fair way of settlement. Under the plan, as now proposed, it may be expected that the power owners will get considerable storage to help out the low water flows, and the cities along the shores of the lakes will get considerable aid in the solution of their flood problems.

The Barge canal plans contemplate drawing from the lakes during the low water periods of the navigation season, by means of large sluice gates at the outlets, by which the volume of water in the lakes between the levels of the maximum and minimum navigation stages will be utilized. This will yield from Cayuga and Seneca lakes alone 8.3 billion cubic feet of storage available during the navigation season and 3.3 billion cubic feet additional after the close of navigation.

On Keuka lake practically the entire run-off of the watershed is now conserved, as very little water ever flows over the spillway of the dam at the outlet of the lake. In some years there is no water wasted at all. Any further useful results from the water could only be obtained by interference with private water rights. The mill at the foot of the lake uses the water as it desires, and those mills on the stream below have to use it as it comes from the tailrace of the upper mill, or let it pass by unused. It is probable that some economies could be secured through a union of all of the power users on the stream by an electric development system, but such a union is clearly a matter of private enterprise.

Skaneateles lake is the source of water supply for the city of Syracuse, and it is not deemed desirable to attempt to use the lake for storage for water power purposes, even were it practicable of accomplishment, lest it might conflict with these other water rights.

Otisco lake is too small both as to drainage area and as to water surface to be of much consequence in the regulation of the Oswego river.

Owasco lake is used as a feeder for the Erie canal and as a source of water supply for the city of Auburn. The lake level is now regulated by a State dam and gates at the outlet. Under a court decision the outlet works must be so operated as to never cause a depth of water of more than thirty inches on the crest of the dam. Mr. J. Walter Ackerman, superintendent of the water works of the city of Auburn, states that he has observed the lands at the head of the lake flooded to the tops of the fences at a time when only thirty inches of water was flowing over the crest of the outlet dam, and at another time the same lands were free from flood water when fifty inches of water was flowing over the crest of the dam. From these facts he argues that the flooding of the lands at the head of the lake is not due to high lake levels. but to insufficient capacity of the inlet channel below the flooded lands. The lands affected by the fifty-inch rise of level are about five hundred acres in extent and are said to be of comparatively small value. It is possible that a rise of fifty inches above the crest of the State dam could be affected on Owasco lake without causing very heavy land damages. The many important industries on the Owasco lake outlet makes further accurate field investigations of the possibilities of storage on this lake very desirable.

Onondaga lake is too small in area of water surface to afford much opportunity for storage, and such storage as might be obtained would be at the expense of damage to property of considerable value on the lake shore.

Canandaigua lake is now regulated to some extent by the village of Canandaigua for the purpose of diluting its sewerage, which is discharged into the outlet. The village maintains a flow of about forty cubic feet per second through regulating gates at the foot of the lake. An examination of the conditions on this lake leads to the conclusion that about three billion cubic feet of storage is practicable above the present sill of the gates at the outlet and at a comparatively small cost. With this storage it is estimated a minimum regulated flow of 190 cubic feet per second could be maintained. This situation is worthy of more detailed surveys and studies.

The Barge canal has constructed a dam at Caughdenoy for controlling the level of Oneida lake, the crest of which is at elevation 369.4. No provisions for maintaining higher water level have been made, except for the use of flash boards, nor has provision been made for drawing off the water in case flash boards are used, nor is there any provision for drawing off the water below the crest of the dam after the close of navigation. Under the Barge Canal Law, controlling works for the purpose of power benefits are not permitted. A lock in the old canal leading out of the lake could be made serviceable for drawing off surplus water by the expenditure of a comparatively small amount of money.

If a movable crest could be arranged on the Caughdenoy dam to hold back the flood water to five feet above the present crest and at the same time never allow floods to rise above that stage, eleven billion cubic feet of storage could be made available during the navigation season. Such a project appears feasible and well worthy of further surveys and study.

Benefits of Storage. In order to show the benefits to accrue from storage to each locality on the Oswego river, the following estimates have been made:

The total fall in the Oswego river from Three Rivers to Lake Ontario is 118.6 feet. With the new dams under construction by the Barge canal at Phoenix, Fulton and Oswego and the construction of the long tailraces recently projected or finished by the power owners, practically this entire head will be made available. On this head the entire volume of storage available during the navigation season will be used each year and occasionally some of the volume available after the close of navigation will be used and these uses will all be within the wheel capacities of the present water power installations. Taking the total planned and proposed additional storage available before the close of navigation as 25,-000,000,000 cubic feet and the net head as 110 feet, the possible power development from the storage, on the Oswego river proper would be equivalent to 8,000 horse power at 80 per cent. efficiency, running continuously 24 hours per day for one year, or 8,000 horse power years.

On the head of 229 feet available on Owasco outlet between the lake and its junction with the Seneca river, the 3.46 billion cubic feet of stored water would develop 2,346 horse power years at 80 per cent. efficiency of the hydraulic machinery.

The total fall on the Seneca river is about 71 feet, all of which is now developed. On the 11 foot fall at Baldwinsville there will be available the storage from lakes Cayuga, Seneca, Owasco and Canandaigua, amounting to 10.5 billion cubic feet and this will produce the equivalent of 336 horse power years.

On the 60-foot fall in Seneca river, the 3.5 billion cubic feet of storage would produce 600 horse power years, but the water to be used by the new canal, which will probably be somewhat greater in quantity than that used by the present canal, will reduce this amount.

On the 169-foot of available fall in the Canadaigua outlet 2,000,-000,000 cubic feet of storage would produce 975 horse power years.

Total power value on the Oswego river system of storage planned for the Barge canal and the proposed additional storage is practically 12,200 horse power years.

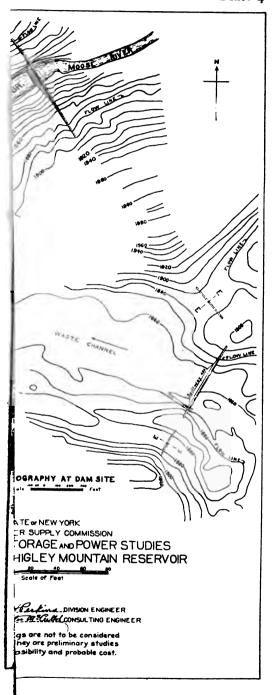
Other Canal Waters.—In considering the Oswego river water power situation, the fact should not be overlooked that all the waters used in the Barge canal coming from the west and one-half of all that are used to furnish the canal at the Rome level must pass down the Oswego river. Thus one-half the waters from the great Hinckley and the Delta reservoirs and all the waters coming from Lake Erie on the west will be necessarily discharged into the Oswego river, because the crossing of this valley is at the lowest level of the canal between Lake Erie and Rome. This water will materially increase the summer flow of the Oswego river and will, of course, be additional to anything accounted for in Table V as coming from the storage in the Oswego watershed. As the traffic on the Oswego canal can hardly be expected to equal the combined traffic on the main canal east and west from Syracuse, much of the canal water will be available for power production.

BLACK RIVER.

During the summer of 1909 reconnaissances were made on the Black river watershed and reported upon in the Fifth Annual Report of the Commission. In accordance with the recommendations then made, surveys of the two most important reservoir sites were made during the season just past. On the fifth of July two parties of engineers under the direction of Mr. Russell Suter,



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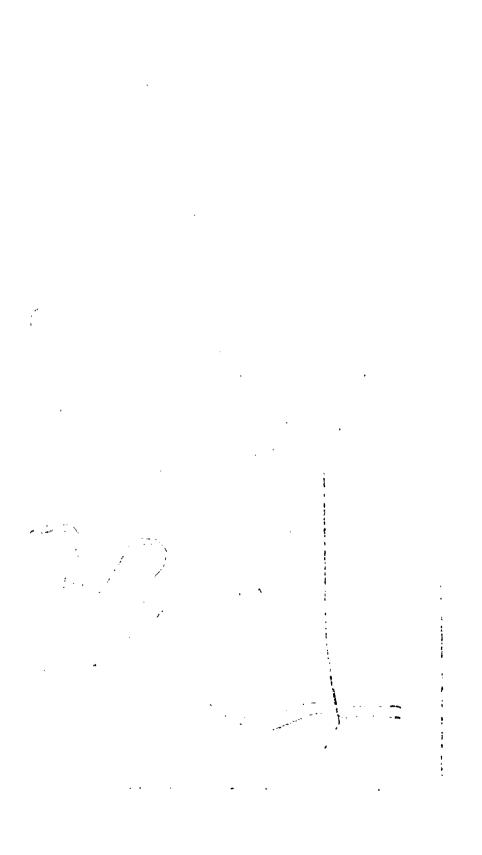
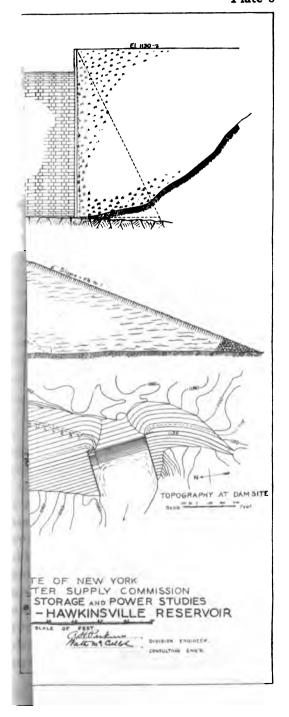


Plate 6





Assistant Engineer, were sent to the Black river and started the surveys at the Hawkinsville reservoir site immediately below the existing state reservoir at Forestport. This survey was completed on August 11th, and the parties were then transferred to the Moose river, a branch of the Black, upon which is located the Higley mountain reservoir site, referred to in last year's report as "The Plains." The field work was continued as long as the men were able to work to advantage and it was safe to keep them in camp, in which they had been living during the summer and fall. On the fifteenth of November, camp was broken and the men returned to Albany to work up their notes, plot the maps and prepare the plans and estimates for the proposed reservoirs.

These surveys disclosed no disappointing features in connection with the proposed reservoirs except that the estimated cost of the Hawkinsville reservoir per unit of benefit to be derived is larger than was anticipated.

The general location of these reservoirs are shown on accompanying maps and photographs. Plate 2 is a general map showing watersheds of the Black, Grasse and Oswegatchie rivers. Plate 3 is a map of the Higley mountain reservoir and Plate 4 shows the proposed dam, gate house, and other outlet works. Plate 5 is a map of the Hawkinsville reservoir and Plate 6 shows the proposed works at the outlet.

Hawkinsville Reservoir.— This reservoir will have a capacity of 5.3 billion cubic feet with a flow line and spillway crest at elevation 1112 feet above sea level. The spillway portion of the dam, 400 feet in length, will be of cyclopean masonry faced with concrete and founded upon bed rock. Plate 6 is from a photograph taken at the dam site. Rock is exposed in the bottom of the stream and a few feet above on the sides. It is an excellent quality of limestone lying in apparently horizontal beds. make suitable connections with the earth embankments forming the end portions of the dam, the plans contemplate the earth embankment being carried all the way across at the back of the masonry spillway. The upstream face of the earth dam will be 3½ to 1 slope and paved with 18-inch stone on 12 inches of gravel. The downstream slope will be 2½ to 1 with a toe of loose rock 20 feet high where the embankment comes in contact with or close to the rock surface. Suitable precautions will be taken to connect the

earth to the rock surface by an impermeable joint. The top width will be 30 feet. The slopes for the earth dam as given above are in excess of current practice and could probably be reduced with safety to 3 to 1 and 2 to 1 respectively, if suitable material is procurable. Further study of the material available for the fills will have to be made before this matter can be definitely stated.

The masonry section is designed in accordance with current practice. The gatehouse is located at the dam and the water is carried to it through the earth section in a culvert founded partly on rock and partly on earth. Special precautions will be taken at the point where the foundations change in order to provide for unequal settlement. Suitable collars on the outside of the culvert and other precautions will be taken to prevent water following along the masonry surfaces through the dam. Water will be drawn from the reservoir through five 48-inch pipes discharging into a pool below. Suitable gates, stoplog grooves, etc., are provided for, as shown on the plan.

If rock should be found to exist near the surface at either of the three saddles across which dikes are to be built, as shown on Plate 5, the cost of the main structure could be very materially lessened by placing the spillway there. This subject should be thoroughly investigated before final plans are prepared, though it is not anticipated that the investigation will disclose ledge within working distance of the surface at any of these points.

The estimated cost of the reservoir complete is \$2,830,000.

Higley Mountain Reservoir.— This reservoir as planned will have a capacity of 5.2 billion cubic feet with spillway crest at elevation 1880. The capacity is limited by the drainage area above, rather than by the natural conditions at the dam site and elsewhere on the basin. The above mentioned capacity affords practically complete regulation of the stream at the dam site. The main dam will be of cyclopean masonry faced with concrete and founded upon granite rock ledge. Plate 8, a reproduction of a photograph taken at the dam site, shows that rock is exposed in the bed of the stream and that it also outcrops at various points along the sides. It is believed to be only a few feet below the surface at the saddles lying to the south of the dam, hence the spillway is located at one of these points. The spillway is to be 450 feet in length and will be provided with a logway at one end.



BLACK RIVER WATERSHED
Proposed Hawkinsville Reservoir. Dam Site Looking Up Stream



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South Branch of Moose River. Proposed Higley Mt. Reservoir
Dam Site Looking Down Stream



BLACK RIVER WATERSHED
South Branch of Moose River. Proposed Higley Mt. Reservoir
Dam Site Looking Up Stream



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Water is to be withdrawn from the reservoir through six 48-inch pipes extending through the main dam. The valve control, location of gate house and other general features are shown on plate 4.

The estimated cost of the reservoir complete is \$1,340,000.

State lands.— The Hawkinsville reservoir is located entirely outside the boundaries of the Adirondack park, and while there will be 56 acres of State lands submerged, these lands do not come within the constitutional prohibition, being improved lands taken for taxes.

The Higley mountain reservoir covers territory composed very largely of State lands. The total water surface is 6.6 square miles or 4,224 acres. Of this total, 3,590 acres are State lands — 1,840 acres forested, and 1,750 acres deforested. There are 1,690 acres of private lands below the taking line — 1,080 acres forested and 610 acres deforested.

The work on these proposed reservoirs has been carried somewhat further in the matter of land surveys than has been done on some previous reservoir surveys. It is believed that no more work will be required in surveying land lines on the Higley mountain reservoir and on the Hawkinsville reservoir the work has been left in such shape that this feature can be carried to completion with a minimum expenditure. Some test pits should be sunk at the Higley mountain dam site before final plans are made. There is every indication that rock foundations are within a few feet of the surface everywhere; but the fact should be definitely settled by test pits and drill borings.

Table VI presents the various features of the effect of storage in these reservoirs. All the data for an exact study has not yet been secured and these figures are preliminary only. Benefits will doubtless be considerably greater than shown because of the fact that the table takes into account only present installations and installations of a capacity equal to the low water flow of the stream at undeveloped sites. No account is taken of possible increases in capacity rendered commercially feasible by the increased flow of the stream due to the use of stored water. A power survey similar to that made on the Hudson and Genesee rivers during the past year, and more stream flow data will make an estimate of these further benefits practicable.

TABLE VI.

BLACK RIVER — EFFECT OF STORAGE ON WATER POWERS.

	Higher 1	dr. RES.	HIGLET MT. RES. HAWKINSVILLE RES.	1	Total	
	Моове В.	L. Black R.	Moose R. L. Black R. U. Black R. L. Black R.	L. Black R.	L. Black R.	
	H. Pyra.	H. Pyrs.	H. Pyrs.	H. Pyrs.	H. Pyra.	H. Pyra. H. Pyra. H. Pyra. H. Pyra. H. Pyra. Per yr. per yr.
1. Present wheel capacity of plants 2. Power available from present flow with present installations in an average year. Power available from present flow with present installations in an everage year.		72,565 61,770	425	72,565 61,770	72,565 61,770	83,301 74,475
o. rover a vanishing set undeveloped sites from installations of capacity equal to information flow, average year. 4. Sum of two preceding items 5. Total gain in power due to storage in an average year.	24,780 8,480	61,770	2,380	61,770 8,235	61,770	12,500 86,975 26,415

Moose river includes S. branch of the Moose from Higley Mountain dam to McKeever and the Moose from McKeever to junction with the Black.

U. Black includes Black from Hawkinaville dam to junction with the Moose.

L. Black includes Black from junction with the Moose to month.

Highey Mountain reserved motivals a total gain of 15,800 H. P.-yrs. per year in power, due to storage of 6.0 billion cubic feet, at an estimated cost of \$1,340,000 or \$78 investment per horsepower of continuous power.

Hawkinaville reservoir affords a total gain of 10,615 H. P.-yrs. per year in power due to storage of 5.7 billion cubic feet at an estimated cost of \$2,850,000 or \$258 investment per horsepower of continuous power.

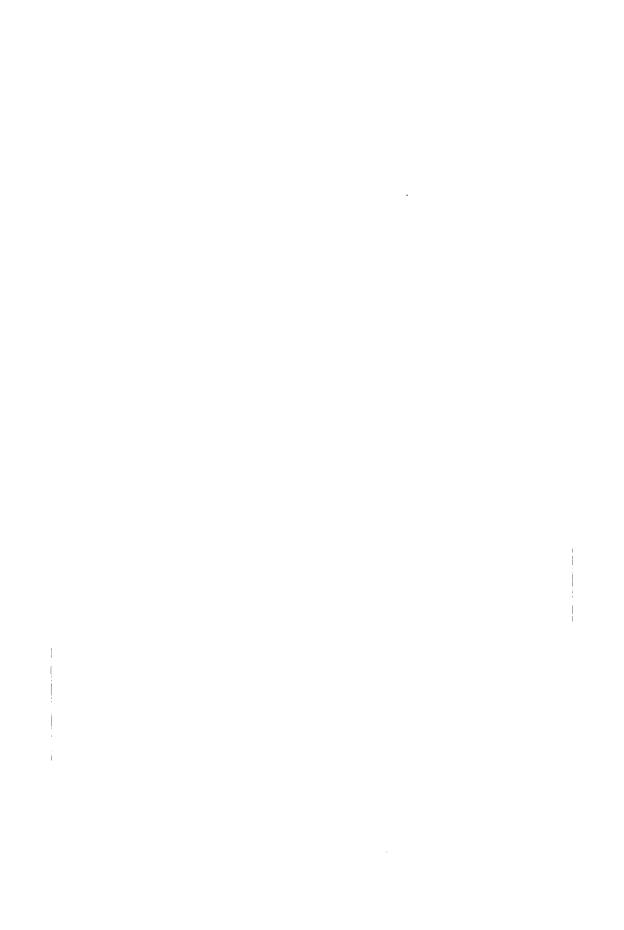


BLACK RIVER WATERSHED
South Branch of Moose River. Basin of the Proposed Higley Mt. Reservoir



BLACK RIVER WATERSHED
Proposed Higley Mt. Reservior. Stillwater on South Branch of Moose River





The investment charge for power due to storage water from the Higley mountain reservoir, with interest at 3½ per cent., will be \$2.45 per year per horse power of continuous power. To this charge must be added depreciation, repairs, and operation charges. For work of the character planned, however, these items will be comparatively small, and the total cost of power derived in this manner will probably not exceed \$3.50 per horse power per year for continuous power. When it is considered that not all the benefits have been included, as explained above, and that no plant in addition to that now installed must be provided to develop this power, one can readily appreciate the remarkable cheapness of this source of energy.

The investment charge for power due to storage water from the Hawkinsville reservoir, with interest at 3½ per cent., will be \$9.24 per year per horse power of continuous power. Adding to this \$1 per horse power per year for depreciation, repairs and operation expenses, the cost of energy from this source will be \$10.24 per year per horse power of continuous power.

WEST CANADA CREEK.

In the fourth annual report attention was called to the West Canada creek and to its undeveloped power possibilities, if effectual regulation of the flow could be accomplished by the construction of storage reservoirs.

As the studies of the storage possibilities on the creek were incomplete in our work of the previous years, it has been thought best to make a more complete reconnaissance of that stream this year to verify the information heretofore collected and studies made and reported upon in our previous reports. Such a reconnaissance was made in the month of November by Mr. Perkins and an assistant engineer.

One of these sites is on the south branch, west of Morehouseville. A dam 110 feet high and 570 feet long would impound 1.87 billion cubic feet of water. The other site is on the main branch of the creek at Swanson dam or the "first Stillwater" where a dam 120 feet high and 1,200 feet long would impound 2.32 billion cubic feet of water. Both of these reservoir possibilities are above the Hinckley reservoir now being built for the Barge canal, but it would be possible and entirely practicable to use the stored water for the generation of power at the dams and again at the high fall below Hinckley by an arrangement to pass through that reservoir the same amount of water as is discharged from the upper ones.

The Morehouseville reservoir would furnish a continuous regulated flow of 94 c. f. s. and the Swanson dam would furnish a regulated flow of 97 c. f. s. through the year. There are power possibilities at the dams of 1,700 horse power and 3,100 horse power respectively, but the cost of the development would be too high to make the proposition commercially feasible.

The storage can be used to better advantage by regulation for the falls below Hinckley.

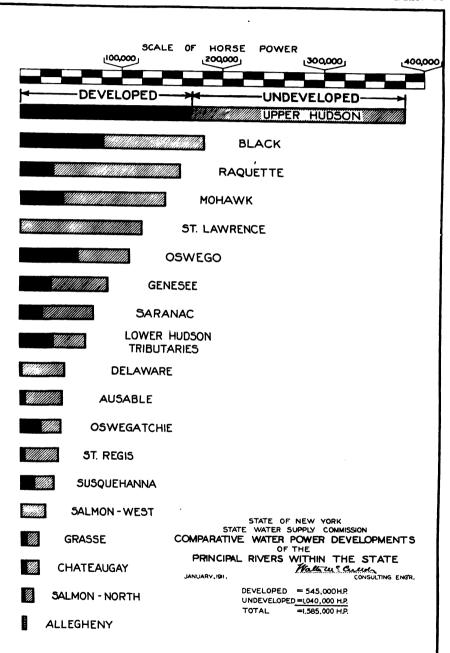
The combined storage of the two reservoirs, amounting to 4.19 billion cubic feet, would effect a regulated flow of 460 c. f. s. in the dry months, which if utilized under 700 feet of the available head below Hinckley would produce 2,900 continuous wheel horse power, 80 per cent. efficiency. Such a development would be more practical and have a more accessible market for the power than any system of developments above Hinckley.

The estimates of cost of these reservoirs and the power development have not been completed at this date.

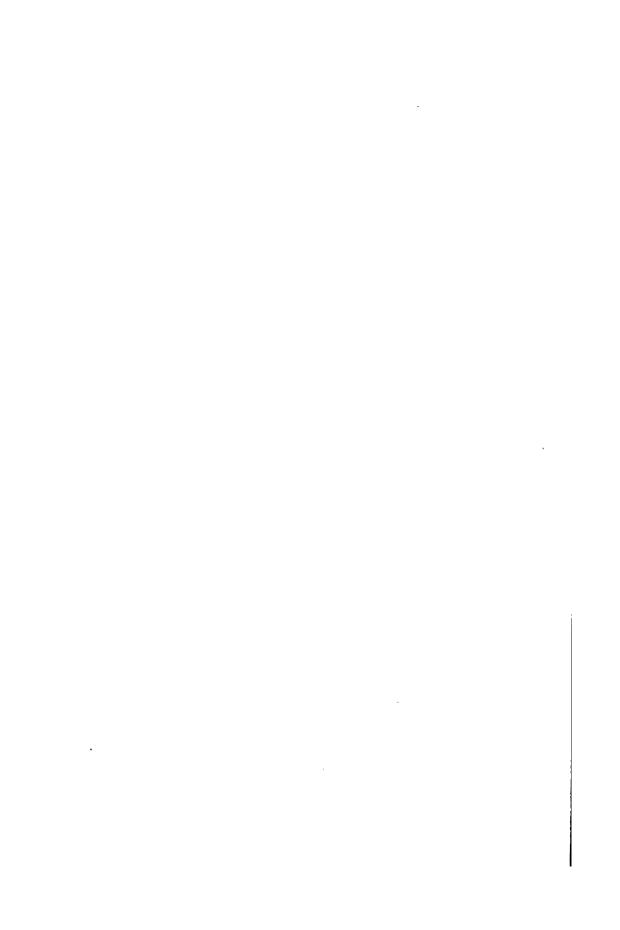
There are possibilities for greater storage in the Hinckley reservoir by the erection of a higher dam than the one planned for the Barge canal, but unfortunately this can not be done under existing laws. The facts and details of this situation have been set forth in our previous reports.

· WATER POWER SURVEYS.

The power survey on the Hudson and Genesee rivers has been made for the purpose of determining with greater accuracy than has been heretofore possible in our investigations, the exact amount of power developed, the conditions under which it is being developed at each of the power plants, the water wheel installation, its capacity and efficiency, the amount of water required for the proper operation of the mills in their present condition, and the amount of water which will be required above the minimum flow



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of the river for the successful operation of the plants without loss of time. The survey further contemplated the collection of data as to the number of days in the year that each plant can run full power, and the number of days in the year which the plant is either completely shut down, or its efficiency reduced, the nature and extent of delays caused by low water and the financial loss to both the employers and the employees at the numerous power plants on the river. The survey also included the collection of data with regard to the possibility of new power developments at sites now undeveloped, and the possible enlargement of existing plants, so as to take full advantage of any storage which may be affected by the construction of reservoirs in the Hudson river watershed.

The party for the power survey on the Hudson river was organized with Mr. B. F. Vandervoort, assistant engineer, in charge, and field work started about the 15th of July, and completed by the end of September, at which time the party was transferred to the Genesee river at Rochester to make a similar survey on that stream. Since the 15th of November, the party has been in the Albany office working up the surveys, and preparing the necessary tables, compiling the data, etc. On these surveys our engineers have been met most cordially by the various power and manufacturing companies along the river and a great deal of valuable data has been collected, and every reasonable facility given us to obtain the information sought.

OFFICE STUDIES.

In the progress reports of the Commission made under the Fuller Act, the basis on which the benefits to water powers from the storage of flood waters were figured was the amount of horsepower added by storage at the time of lowest water in the streams in an average dry year. The limitations of this method have always been recognized and explanations of the figures made accordingly. At the time they were used it was felt that a more scientific basis for figuring the power benefits would be desirable, a method that would not only take into account the maximum rate at which energy would be added to the stream but would also show the total energy added in the year in terms of horsepower hours or horse-

power years. The difference to the power users whether 10,000 horsepower is added to the stream for one hour or one month would obviously be very great.

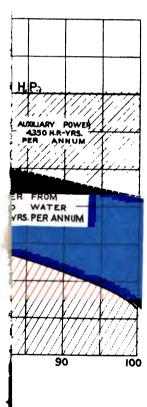
Considerable time has been devoted to the study of this subject by our engineers during the past season, and a new method of computing benefits devised. The method previously used had the advantage of being readily comprehended by the non-technical person and of being readily applied with a limited amount of data. On the other hand, the utilization of the stored water so as to absolutely insure a fixed minimum flow in all years, while perhaps best for streams whose power is not developed up to the limit leads to a very uneconomical use of the reservoirs on streams which are highly developed as to power. As a condition of high ratio of development exists on the streams where storage is most valuable and most sought for, and as this condition will become more and more pronounced on all power streams, it is apparent that the subject of the basis of figuring the power benefits is of importance in securing a proper view of the relation of water storage to water power development. As an example of the distortion of view caused by the method heretofore used may be mentioned the case of the Oswego river. This river has a high ratio of development, that is, the ratio of the wheel capacity installed, to the low water flow of the stream is high. When the method of regulating for a minimum steady low water flow is applied to this river it is found that 11,000,000,000 cubic feet of storage would have been used to its fullest extent only once in the ten years between 1897 and 1906 inclusive. During six of the ten years, it would not have been used at all, and during two years only about one-half of the capacity would have been used. From these premises it was concluded and stated in previous reports that storage on the Oswego was not of great value. It is clear that capital if invested for use only once in ten years must when it is used, yield a very large return. Such a method of management of a storage reservoir would call forth just criticism on the part of the power owners on a stream when they discovered that after money had been spent for auxiliary power during the low water season, the storage reservoir above them still remained full of water. Another instance where the former method of comSION CURVES

FALLS.

PER CENT.

Division Engineer.

Consulting Engineer.





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putation led to a wrong conclusion was in comparisons between reservoirs to determine their relative values. That method led to the conclusion that a small amount of storage on a stream was of much greater power value per unit of volume than a larger amount. This may be true for an undeveloped stream, but it is not true for a fully developed one.

In studying the subject this year it was assumed that from experience and by computation, there could be deduced a method for an average rate of release of stored waters so that while the assurance of a certain minimum flow would not be unduly sacrificed, the entire volume of stored water could be used practically every year, and in most cases at least a portion of the storage capacity of the reservoir could be used more than once each year. and at the same time, while the stored water is being released the flow would never exceed the wheel capacity of the economic development of the regulated stream. It is now believed that such a method of regulation is entirely practicable, or it can at least be very nearly realized, and that the benefits to power owners would be very much greater than if only a certain assurance of a minimum low water flow were attempted by the construction of storage reservoirs. The studies were made graphically and the results in the form of two typical diagrams are submitted herewith. Plates 11 and 13.

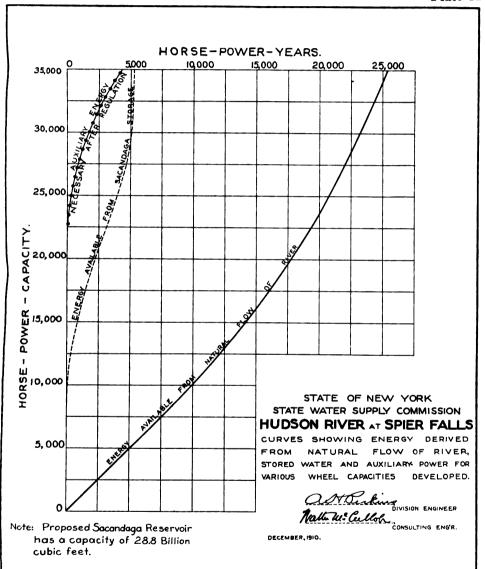
The diagram on Plate 11 gives the conditions at Spier Falls dam as they would be if the Sacandaga reservoir were built and operated as above proposed, which is typical for the Hudson river. The diagram is constructed as follows. monthly discharges of the river as shown by all the stream flow records available were arranged in a table in the order of their magnitude, and the percentage of time during which a given horse power could have been developed was then computed from this table. With the percentage of time for an abscissa and the given number of horse power as an ordinate, a point was determined and plotted. Through a succession of points thus obtained the curve marked "Natural Flow of River" was drawn. If any point be taken on this curve the number read vertically below it at the bottom of the diagram is the percentage of the time on the average that the power read horizontally opposite it to the left could be developed by the natural flow of the river.

In a similar manner on the basis of the discharge of stored water, the curve marked "Regulated Flow of River" was plotted. The present wheel installation is shown on the diagram as a horizontal line.

Several important deductions can be made directly from this diagram. The area bounded by the present installation line, the natural-flow-of-river curve, and the axes of co-ordinates (the red area) is, when properly integrated and interpreted, the average energy furnished by the stream per year. The area below the line of present installation and between the curves representing the natural-flow-of-river and the regulated-flow-of-river (the blue area) is, when properly integrated and interpreted, the energy furnished by stored water in the average year.

For the purpose of convenient study "energy curves" have been plotted from the "power-percentage-of-time curves," for several important waterfalls. Plate 12 is such a set of curves for Spier Falls. From these diagrams may be read the amount of power that would be derived from each of the three sources of energy (natural flow, Sacandaga storage and auxiliary plant) for any given capacity of development. For example, with a development of 30,000 horse power water wheel capacity at Spier Falls, the energy from the natural flow of the stream would be 23,000 horse power years per annum; the energy derived from stored water would be 5,000 horse power years per annum, and the energy to be derived from some auxiliary power would be 2,000 horse power years per annum.

In connection with the power benefit investigations, extensive studies have been made from an engineering view point, of various laws relating to water storage, water power, the construction of dams by the State, and the general principles of taxation for benefits accruing from public improvement works. Special attention has been given to those New York State laws which have a bearing upon the execution of the plan suggested by your Commission in the last annual report, for the progressive development of the water powers of the State for a State revenue. This study was made by Mr. Perkins, under my direction, and a report, with extracts from the laws, has been submitted by him and was referred to Commissioner Milo M. Acker in October.





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HUDSON RIVER POWER SURVEY.

In our previous studies of the benefits to be derived from the storage of flood waters for power purposes, only general effects have been considered. Data as to exact heads, pondage uses and other essential factors were lacking for a detailed study. For the purpose of securing additional data, the power surveys were undertaken during the past season. Much of the material secured must be treated as more or less confidential, and much of it need not be considered in our reports. It has all been worked up and the results put in tabular form and filed for future reference. The principal physical conditions on the river may be summarized in the following statements with regard to the respective dams and power sites. These statements are also explanatory of Table VII submitted herewith.

TROY TO HADLEY.

Troy Dam.— Owing to the fact that the United States Government is now considering the reconstruction of this dam, or the substitution of a new one in another location, it was thought inadvisable for us to undertake any work at this point. It is understood that the proposed new dam will be located about 2,000 feet upstream from the existing one, and have the spillway crest at elevation 14.4 feet, or 1.9 feet higher than the present dam. The tide fluctuates about 2 feet at the foot of the present dam, so the proposed dam would create an average working head of about 13 feet.

Barge Canal.—Between Troy and Fort Edward the river is being canalized over a considerable portion of the route and where not in the river channel the canal follows it closely the rest of the way. The pool levels proposed by the Barge canal plans determine the heads at the several dam sites along this stretch of the river. In order to secure the fullest use of the water and gain additional head without causing the backwater from one dam during high water periods to interfere with the tail water at the dam next above, flashboards could be used in some cases to great advantage. With such a system of flashboards all the fall in the river between Troy and the mouth of the Sacandaga could be developed, except the small amount necessary to keep the water

in motion, and 8 feet of fall between the tail water at the Still-water dam and the Mechanicville pool. The utilization of this 8 feet is not commercially feasible owing to the lack of a suitable dam site, interference with Barge canal plans, and the great length and size required for a power canal to accomplish the desired end.

Waterford.— The fall of the river between the tail water of the lower Mechanicville plant and the pool above the proposed Troy dam will be concentrated at a point near Waterford by the proposed Barge canal dam to be located at the latter place. The crest elevation of this dam will be 28.7, giving a working head of 14 feet. The power which is possible of development at this dam will be the property of the State, to be used or disposed of under such laws as may be enacted in the future.

Mechanicville, lower dam.— This dam concentrates the entire head between the proposed Waterford pool level and the tail water below the upper Mechanicville dam, affording a working head of 18 feet.

Mechanicville, upper dam.— The working head here is 17.5 feet, and this could be increased to 19 feet by the use of flashboards.

Between Mechanicville and Stillwater occurs the 8 feet of unutilized fall heretofore referred to.

Stillwater.— The working head here is 8 feet. Owing to the low head, this fall is developed only up to the low water flow of the stream. With the use of flashboards anther foot of working head could be obtained without interfering with the Thompson water powers, next above.

Thompson.— The dam at this point concentrates all that is practicable of the 22 feet of head between the Stillwater pool below it and the Fort Miller tailwater, next above. No increase in head is possible without interference with the latter.

Fort Miller.— The head is 9.5 feet at this point, but 10 feet could be secured by clearing out the tail race.

Crocker's Reef Dam.— This dam was constructed by the State. It creates a head of 4 feet, which could be increased by use of flash-boards to 5 feet, but this is too small a fall to be commercially at-

tractive. It has been suggested that this head might be advantageously combined with that at Fort Miller by raising the dam at the latter place. A study of the commercial and engineering features of such a plan is recommended.

Fort Edward.— The working head of 19 feet at this point is a complete development of the entire fall between the Crocker's Reef pool and the tail water of the Hudson Falls plants, next above.

Hudson Falls.— Power is developed here at two dams. The lower plant works under a head of 57 feet in three stages, at Baker's falls and the upper one under a head of 13 feet at a point 2,200 feet up stream from the head of the falls proper. The water above Baker's falls is diverted by a timber crib dam in bad condition. The head could be increased 5 feet by the construction of a new dam. Within the past three years a development has been made on the west side of the river by the construction of an intake, head race and power house, utilizing the full available head of the falls. The head of 13 feet at the upper dam cannot be increased without interfering with the Glens Falls water powers.

Glens Falls.— The working head is 40 feet at this point and if the old diversion dam is replaced by a new one, it appears feasible to increase this to 45 feet.

Feeder dam.— This dam was built by the State for the purpose of diverting water to the Champlain canal. During the navigation season, 300 second feet is withdrawn from the Hudson. The total available head is 15 feet, but the working head is 13 feet, two feet being lost in tailrace. The dam could not be raised without diminishing the available head at Sherman Island.

Sherman Island project.— Sherman Island is located 8 miles above Glens Falls measured along the course of the river and 3 miles below Spier Falls. At this point is located the only remaining large undeveloped power site on the Hudson between Troy and Hadley. It would utilize all the head between the feeder dam pool and Spier Falls tail water. The dam to utilize this possibility would be 51 feet high above the present water surface, and 800 feet long on top, and have the spillway crest at elevation 350. With the stream flow regulated by the Sacandaga reservoir, 25,200 horse power could be operated 60 per cent. of the time.

TABLE VII. Hudson River Power Developments Between Troy and Mouth of Sacandaga River.

			Н	REBENT (PRESENT CONDITIONS	at)	CONDITION	ONS AFTE	CONDITIONS AFTER REGULATION WITH 29 BILLI OF STORAGE AND FULL IMPROVEMENT	N WITH	WITH 29 BILLION CU. FT. IMPROVENENT.	s Cu. Fr.
	Miles	Drainage area				H.P. yrs.	H.Pyrs. per year		H. P. capacity of		AUXILIARY POWER REQUIRED	H. P.
	bany	miles	Working head, ft.	Rated H. P. of turbines	Rated H. P. of auxiliary power	available from water in average year	within present wheel capacity from storage	Ultimate working head	for 24-hr. continuous power 60% of average year	Rated H. P.	H. P. years per year	storage storage with capacity given in column X
I	111	III	II		4	ИИ	VIII	IX	×	IX	ТХ	тих
Troy Lower Mechanicville Mechanicville Stillwater Thompson	32038	8,100 4,587 3,780 2,890	₹ ~	72 FULLY 7,451 7,600 8,527 1,024	8-1-1-70	PARTIALLY DEVELOPEE 450 2,451 6,700 760 450 7,100 970 150 1,024	YELOPED 970 970		12,800 10,450 11,000 4,300	9,100 5,330 5,620 1,800	1,420 880 930 340	1,185 1,290 1,860 575
	38 50 53	28,888 28,888 28,880 28,08 28,08 28,08	and 17 9.5 19 70 40	4,590 1,291 6,956 17,872 20,536	1,460	3,800 1,291 16,000 13,700	690 1,120 1,890 2,380	and 17 10 19 75 45	28,73,800 17,250 17,200 17,200	1, 650 940 1, 020 1, 020 1, 020 1, 020	000 000 000 000 000 000 000 000 000 00	890 1,180 2,870 800 800
Spier Falls Palmer Falls Corinth	3288	22.73	28.78 188 188	35,000 24,850 400		25,300 21,400 400	5,100 3,370	2882	30,200 34,400 7,650	2,040 040 040	1,690 1,920 430	242 1,245
Totals	:		401	131,697	9,510	105,266	16,280	429	179,000	59,320	11,410	27,165
Waterford Grocker's Reef Sherman Island	2142	4,620 2,875 2,782	≱	ATER POV	WATER POWER UNDEVELOPED	VELOPED	:::	14 5 6	8,150 1,900 25,200	4,150 510 6,730	680 110 1,410	1,000 310 4,110
Totals				:				85	35,250	11,390	2,200	5,440
Grand totals	:	:	401	131,697	9,510	105,266	16,280	514	214,250	70,710	13,610	32,585
Grand totals		:	401	131,697	9,510	105,266	16,280	514	23	14,250		70,710

Spier Falls.— The working head at the Spier Falls dam is 76 feet with a possible increase to 79 feet by the use of flashboards. Pondage is available over about 15,732,000 square feet; so that low load factors can be readily taken care of, but such manipulation of the stream flow disturbs the other powers below the dam having less pondage.

Palmer Falls.—A dam at the head of the natural fall at this point makes available a total gross head of 85 feet developed in two stages with working heads of 36 and 29 feet respectively. It appears feasible to increase the total gross head to 90 feet.

Corinth.— This power is not fully developed. The working head is 18 feet, and 20 feet is the maximum available.

HADLEY TO INDIAN LAKE RESERVOIR.

This survey was undertaken for the purpose of securing a profile of the river, a close estimate of the amount and value of the water powers in this section of the river, and an instrumental reconnaissance of the possibility of diverting Cedar river into Indian river for storage in an enlarged Indian river reservoir as proposed in 1909 report of the Commission.

Hadley.— The only power developed at present on this section of the river is at Hadley, immediately above the mouth of the Sacandaga river. This plant owned by the Union Bag and Paper Company is used for pulp grinding and paper manufacturing. The head now developed is 18.5 feet, and is created by a timber crib dam across the narrow rock gorge adjoining the mill. rated capacity of the installation is 2,067 horse power. There is a good site here for a higher dam and considerable pondage. late Geo. W. Rafter, in the report of the State Engineer for 1895, proposed a storage reservoir here and estimated its capacity at from 4 to 4.5 billion cubic feet with flow line at about elevation In 1907 a partial survey of this project was made by this Commission and referred to in the reports of Mr. Freeman and Mr. Ropes. This survey showed that with the flow line at elevation 610, the capacity of the reservoir would be not over 2,000,-000,000, and computations based upon the U.S.G. S. sheets show it to be about 1.4 billion cubic feet. Its importance is therefore

very slight as a storage reservoir. Its greatest value would be for pondage purposes in connection with a large reservoir at Indian river, and the principal use of a dam at Hadley to elevation 610, would be for creation of additional head and a consequent increase in power. The gross head available would then be 63 feet. Both the Schroon and Indian river reservoirs would furnish water to it if built; but it is thought advisable at this time to consider only the Indian river storage in this connection. With the enlarged Indian river reservoir a flow of 1,060 second feet could be maintained continuously, and this flow on 63 feet of head would yield 6,100 horse power. Before the project could be carried out, nearly nine miles of the Adirondack division of the Delaware and Hudson rairoad would have to be relocated in very difficult country at a cost of probably not less than \$300,000.

It is a matter for close surveys and estimates to determine whether the expense of constructing this reservoir would be justified. It is thought that until water power is more valuable than now, such expense would not be justified.

Above Hadley, although 84 per cent. of the entire fall in the river could have been easily developed, there are no power developments in the Hudson river proper. In the section from Hadley to North Creek, 36 miles, the Delaware and Hudson River Railroad occupies the valley, rendering power development expensive in spite of the many favorable sites for dams. Above North Creek state lands interfere with development by private enterprise. With these difficulties in the way and the legal disability of private companies as regards acquiring lands and water rights for power developments, it is probable that the State alone can meet all the requirements in the development of the very valuable powers on this portion of the Hudson from Hadley to Indian river reservoir of which the following have been noted.

Millington Brook Project.—About 900 feet south of the mouth of Millington brook a dam with spillway crest at elevation 710 would create 60 feet of head. This dam would be 1,100 feet long and 60 feet high. Rock outcrops on both sides of the river, indicating suitable foundations. The regulated flow using 11.6 billion cubic feet of storage from Indian River reservoir is estimated

at 800 second-feet, and the power at 4,400 continuous horse power. Four and one-half miles of the Adirondack branch of the Delaware and Hudson River Railroad would have to be relocated.

The Glen Project.—About one-half mile below the Glen, a dam with spillway crest at elevation 745 and creating a head of 30 feet appears feasible. The dam would be 450 feet long and 30 feet high. The foundations would be rock. One and one-half miles of the Delaware and Hudson Railroad would have to be relocated. The regulated flow is estimated at 790 second-feet and the power at 2,200 continuous horse power.

Gage Mountain Project.— Near the foot of Gage mountain, one and one-half miles below Mill creek, there is a good dam site with rock foundations. A dam 30 feet in height — crest elevation 817—and a pressure tunnel two miles long would furnish a gross head of 70 feet and a working head of 60 feet. The regulated flow is estimated at 780 second-feet and the power at 4,200 continuous horse power.

Huckleberry Mountain Project.—At the foot of Huckleberry mountain, about one mile above Riverside, judging from the rock outcrops on the sides, there appears to be rock foundations for a dam. The spillway crest would be at elevation 1025, the length at the top 1,200 feet and the height 150 feet above the river bed. In connection with a tunnel 2½ miles long, there would be available a total gross head of 195 feet and a net working head of 182 feet. The regulated flow is estimated at 770 second-feet and the power at 12,700 continuous horse power. Eleven miles of the Delaware and Hudson Railroad would have to be relocated, and a small part of the village of North Creek would be flooded.

North River Project.—About 3,000 feet below North River, rock outcrops on both sides of the river. A dam to elevation 1120 would have a length of crest of 950 feet and would be 85 feet high above the bed of the stream. This dam and a tunnel 3,500 feet long would make available a gross head of 90 feet and a working head of 86 feet. The regulated flow is estimated at 750 second-feet and the power at 5,900 continuous horse power. This project would flood the village of North River and require the relocation of about 3 miles of highway.

Kettle Mountain Project.— The proposed damsite is about 3 miles above the confluence of the Boreas and Hudson rivers. Although no ledge outcrops appear on the surface, the high steep banks and the general geological character of this region would indicate rock near the surface. The dam would be built with spillway crest at elevation 1418, would be 800 feet long on top and 190 feet high above the river bed. The impounded water would back up to the mouth of Indian river. This dam in connection with a tunnel 23/4 miles long would make available a gross head of 296 feet and a working head of 280 feet. The regulated flow is estimated at 700 second-feet and the power at 17,800 continuous horse power.

Indian River Reservoir.— In the 1909 report, pages 517-18, the enlargement of the Indian river reservoir by the construction of a new dam at the head of Indian river falls and the diversion of the waters of Cedar river into it, was proposed. The proposed diversion of Cedar river contemplated a dam on Cedar river and a canal across the divide between the Cedar river and Indian river because no suitable reservoir sites exist on Cedar river. The controlling feature of this combination reservoir is the available runoff from the 197 square miles of drainage area on the Indian river and 94 square miles on Cedar river rather than the available storage capacity.

While a storage capacity of 29 million cubic feet per square mile practically controls the Sacandaga river, 40 million cubic feet per square mile is a more usual figure and is probably more nearly the amount necessary for the control of the Indian and Cedar rivers because the natural lake areas, aside from the reservoir areas on these streams, aggregate considerably less per unit of area of water shed than on the Sacandaga. There are no stream flow records on the Cedar river and those on the Indian are inadequate. The rainfall map of the state shows that the drainage areas of these two streams will be prolific producers of runoff and from a study of the Sacandaga it appears that a somewhat abnormally large percentage of the precipitation occurs during the "storage period," i. e., from December to May inclusive. In view of these facts a storage capacity of 40 million cubic feet per square mile, or 11.6 billion cubic feet is assummed as the practical limit of storage development for this area.

The very valuable powers on the Hudson between Indian river dam and the mouth of the Boreas river belonging to the state make the study of the hydrography of this region important. Gaging stations should be established on the Cedar and Indian rivers at an early date.

This season's surveys disclosed the fact that the Indian river dam at the site and up to the elevation proposed in the 1909 report, is impracticable. The U. S. G. S. sheet, upon which the studies were based, is somewhat in error at this point. A suitable damsite does exist, however, approximately a mile below, at which point a dam 140 feet high and 850 feet in crest length will raise the water to elevation 1660.

These surveys show also that instead of a dam and canal as proposed in the previous report, the damsite on the Cedar river is so good that it will probably be more economical to build a higher dam for a flow line at elevation of 1680, and thereby eliminate the necessity of a diverting canal. There is a saddle in the hills dividing the Cedar river reservoir basin from that of the Indian river, whose crest is at elevation 1671, and over which the water would naturally flow if the higher dam were built.

The dam now proposed would be about 43 feet high, 80 feet long on the bottom and 270 feet long on top. If the lower dam were built the diverting canal across the divide would be 2,200 feet long and 10 feet deep.

The Cedar river extends nine miles below the site of the proposed dam. The diversion of the water from this course would not be serious, however, because there are no riparian lands of value on this stretch. The combined capacity of the two reservoirs would be 11.6 billion cubic feet.

Between the surface of the water in the Indian river reservoir as above projected, and the junction of the Indian river with the Hudson, there is a total fall of 242 feet. Of this 50 feet should be allowed for storage capacity and 10 feet for loss of head in delivering the water through the 9,000 feet of distance. The minimum head available for power development will then be 182 feet, and with a regulated flow in the stream of 582 second-feet which is possible, this would give 9,600 horse power at 80 per cent. efficiency. With the average available head of 207 feet, 10,950

horse power could be developed. As the reservoir will be full a considerable portion of the time and never empty for any great length of time, the latter figure is a fairer one to assume. regulation for this section of the river is justifiable on the ground that with the Sacandaga storage, which will probably be accomplished first, a large percentage of the drainage area of the Hudson will be controlled that regulation for best results at the Indian river dam will also produce approximately best results at points lower down the river. This will be apparent from the self-evident statement that if the entire stream were controlled, then a steady flow from each branch would produce a steady flow in the main channel. A further reason for this lies in the fact that the economic use of the water requires a wheel development which can be run at full capacity, say 60 per cent. of the time. There is thus, without any loss of energy, considerable opportunity for fluctuation of regulated flow within the economic wheel capacity during low water periods, while the stored water is being used to full advantage each season.

The developments herein proposed on the Hudson river and its branches would utilize 940 feet out of a total fall of 1,113 feet between the spillway crest of the proposed Indian river dam and the tail water at the Hadley dam. It has not been practicable to prepare accurate estimates of cost of these projects owing to lack of sufficient data, but we believe that none of them will exceed a cost of \$200 per horsepower.

Table VIII is a resumé of the foregoing statements and shows also the economic developments figured on the basis of continuous operation 60 per cent. of the time and other elements based on Spier Falls data.

If to the total power indicated in this table there is added the 58,000 horsepower of continuous power, and 69,500 horsepower of 60 per cent. power, which may be practically developed on the Sacandaga, there results the grand total of 122,200 continuous horsepower, or 160,000 horsepower 60 per cent. of the year, of undeveloped water power on the Hudson and Sacandaga rivers above their junction.

To deliver Sacandaga power in New York city would require no greater feat of electrical transmission than is now being successfully accomplished with power from Niagara Falls.

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		2,067 H. P. now	developed			
KE.	Miles of railroad to be relocated	9.0	4	10.5		18.0
Hudson Kiver Fower Frojects Between Hadley and Indian Lake.	Estimated 60% power† average year	8,600	3,100	17.8	25,100 15,400	90,500
	Maximum continuous H. P. with regulated flow average year	6,100	4.2.4 2006 2006	12,700	17,800 10,900	64,200
N HADLE	Net head	Feet 63	888	888	280	896
DETWEE	Estimated regulated flow*	Sec. ft. 1,060	2,500 2,500	770	200 280	:
COLECTS	Spillway crest elev.	Fed 620	745	1,025	1,418	
KIVER POWER F	Drainage area	Sq. miles 1,659	927 902 871	839 780	634 291	
	Distance from Albany‡	Miles 76	288	105	124 132	:
Hudson	PROJECT	Hadley	Millington Brook. The Glen.	Huckleberry Mountain North River	Kettle Mountain Indian River	Totals

With the Niagara developments at the western end of the State, the Hudson developments at the eastern end and the developments on the Genesee, Oswego and Black rivers and Canada creeks, there is evidently enough power available to make New York the manufacturing center of the United States. When this fact is considered in connection with the magnificent and unexcelled transportation facilities by canal and rail alongside of which this power may be delivered, and the large urban population in the midst of which the power can be used, thus insuring a labor supply, it is clear that the only thing preventing New York State from becoming such a center is New York State herself.

GENESEE RIVER.

In addition to the surveys and investigations prosecuted on the Genesee river in connection with the proposed improvement under the River Improvement Act, a power survey was made at Rochester and Mount Morris in the same manner and for the same purpose as that made upon the Hudson river. Our engineers were accorded the same cordial treatment on the Genesee river as was given them on the Hudson, and every opportunity was afforded them to make a careful study and survey of the numerous power plants on the stream. This power survey secured for the Commission a large amount of detailed information which has been tabulated and preserved.

ROCHESTER POWERS.

The development of the Genesee river for the production of power within the city of Rochester is made in four heads or falls. Three are obtained at the three successive natural falls over which the river passes in its course through the city and the fourth head is created by a dam known as the Johnson and Seymour dam, constructed across the stream about 600 feet above Court street.

The Johnson and Seymour dam, which creates the first head proceeding down stream within Rochester, is a masonry structure with a timber crest and vertical face; is straight in plan, 400 feet in length, and has a height of 6 feet measured from the ledge rock of the river bed on which it is founded to the timber crest. At this dam, the stream flow is divided equally between the

Johnson and Seymour race on the east side and the Carroll and Fitzhugh race on the west side of the river.

The Johnson & Seymour race is 2,370 feet long, varying in width from 20 to 70 feet. The heads in use on this race at the present time vary from 16 feet to 20 feet with a mean value of 17.3 feet. The water rights on the race are of four classes; first, or superior rights, and second, third and fourth rights. Mr. W. S. McMillan, commissioner for the race, states that the rights are distinguished as follows:

Fourth rights are those that are cut off when one-half the flow of the river is less than 14,000 cubic feet per minute.

Third rights, those cut off for flows of less than 12,000 cubic feet per minute.

Second rights, those cut off for flows of less than 10,000 cubic feet per minute.

First rights, those entitled at all times to their proportionate share of the flow of the river.

Mr. McMillan states, however, that in the actual control of the race, the commissioners have made no distinction between the second, third and fourths rights, but have allowed them all their proportionate amount of the flow of the race until it became less than 10,000 cubic feet per minute, at which time all the inferior rights were cut off. There are 51.5 water rights on the race owned by twelve different owners — 19 firsts, owned by six different individuals, and 32.5 inferior rights owned by ten different owners.

The Carroll and Fitzhugh race takes water from the river at the west end of the Johnson & Seymour dam and is entitled to the use of half the flow of the river. The race has a length of 1,650 feet and a width of about 60 feet. The heads in use on this race at the present time vary from 16 to 19 feet. On this race there are 76 equal water rights held at present by eight different owners.

Pondage over an area of 3,600,000 square feet is available above the Johnson & Seymour dam. This pondage while directly available to only those on the two races, is of course valuable to the powers below having a similar load factor to those on the upper races.

The second head in Rochester, proceeding down stream occurs at the Upper Falls. This natural fall is a few feet less than 90 feet in height, the head available being increased to 92 feet gross by a low diverting dam. The diverting dam furnishes pondage over an area of about 720,000 square feet. From the diverting dam the water is led into "Brown's" race on the west side and into a race leading to the Rochester Railway and Light Co.'s station No. 4 on the east side. The water is divided equally between the two races.

Brown's race is 1,860 feet long, 25 feet to 49 feet in width and 10 feet deep. There are 80 equal water rights on this race, held at present by 15 different owners.

Station No. 4 of the Rochester Railway and Light Company is located immediately adjacent to the falls and receives its water from an intake canal as noted above. This plant is not a modern plant, and probably does not make very economical use of the water available.

Seven thousand eight hundred feet down stream from the Upper Falls described above occur the Middle Falls. The power at this point is all owned by the Rochester Railway and Light Company and used in their station No. 15. This plant is located at the west end of the fall and operates under a head of 28 feet. The diversion dam is a combined timber and masonry structure founded on ledge rock. It has a vertical face, 7 feet high, a length of 450 feet, and makes a pondage area of 1,160,000 square feet.

Station No. 15 of the Rochester Railway and Light Company is a modern, well equipped generating plant of 2,700 horse power wheel capacity.

One thousand feet further down are the Lower Falls where the flow of the stream under 95 feet of head is used in station No. 5 of the Rochester Railway and Light Company. The wheel installation at this station is 10,200 horse power

The following table exhibits the present and future practicable power conditions on the Genesee river at Rochester as explained in the foregoing statements.

TABLE IX.

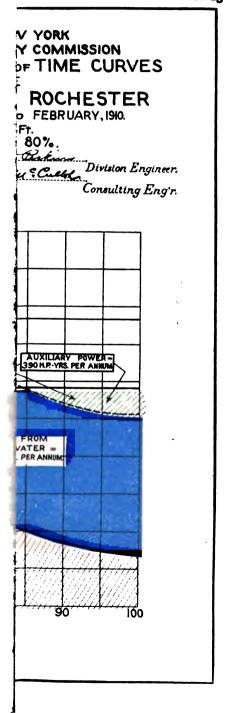
GENESEE RIVER AT ROCHESTER. Effect of Storage on Water Powers.

		PRESENT C	PRESENT CONDITIONS		CONDITION	8 AFTER RI STOR	CONDITIONS AFTER REGULATION WITH 13.5 BILLION CUBIC FEBT OF STORAGE AND FULL IMPROVEMENT	7rm 13.5 B L Improve	ILLION CUB	IC FEST OF
				0.0	H. P. yrs. per year		H. P.	AUXILIARY POWER REQUIRED	T POWER	H. P. yra.
NAME OF FALL	Working head ft.	Rated H. P. of turbines	Rated H. P. of auxiliary power	developed by water during an average year	added within present wheel capacity from storage	Ultimate working head	of turbines that may be operated continu- ously 60% of average	Rated H. P.	Н. Р. угз. рег уеаг	storage with capacity given in column VIII
I Sommon & Sommons dom	11 21 91	III	IV	1 584	1/A	III	VIII,	IX	X	XI
Upper Falls Middle Falls Lower Falls	80 50 50 50 50 50 50 50 50 50 50 50 50 50	14,278 10,200 200,200	16,370	10,372 2,280 8,440	2,654.5 420.0 1,790.0	2222	15,897 5,910 16,840	5,582 5,075 5,920	1,179.3 438.0 1,250.0	3,187 1,180 3,375
Totals	228.7	29,220	16,987	22,656	5,168.1	243	42,079	14,786	8,121.8	8,428
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Barge Canal Plans.— The route finally adopted by the Barge canal authorities through the city of Rochester crosses the Genesee river in a pool to be formed in the river by a movable dam to be constructed about 300 feet south of the present Johnson and Seymour dam. It is proposed to maintain the pool at elevation 512.6 (Barge canal datum) or 9.5 feet above the crest of the Johnson and Seymour dam. Guard locks will be installed in the canal on either side of the river, also large capacity by-pass culverts around the easterly lock for the operation of the lower locks at this point. The Barge canal plans do not contemplate either the abstraction of water from the Genesee flow or the addition of water thereto, all required supplies coming down the canal from Lake Erie. It is the intention to keep the dam up only during the navigation season, it being feared that serious flood damages might result in case the mechanism of the dam failed to work because of ice or otherwise when a flood was impending.

Effect of Barge Canal Plans on Rochester Powers.—With proper arrangements, the Barge canal works may be made to materially increase the Rochester powers and without detriment to canal operations. On the other hand, unless such arrangements are made actions for damages may ensue because of the decrease in the pondage now available to the power users from the pond above the Johnson and Seymour dam, the larger part of which pondage will be cut off by the new dam. If the proper arrangements are made, the extra 9.5 feet of head may be made available for use during the period of canal operation, which period corresponds very nearly to the low water season of the year, and hence this power, operated in connection with present installations, would be practically equal in value to the same amount of horse power operated for the entire year. With the river regulated by means of the 13.5 billion cubic feet of storage proposed at Portage a minimum flow of 1,240 cubic feet per second could be maintained, which on 9.5 feet of fall would produce 1.070 (minimum) 24-hour 7-day wheel horse power.

Advantages of Pondage for Power Operation.— Local pondage is of very great importance to Rochester powers because of the fact that the average load factor is 62 per cent. for 24,875 horse





power out of the 29,220 horse power of the wheel capacity now installed. The total head which can ultimately be developed at Rochester is 242 feet, not including the 9.5 feet at the proposed Barge canal dam; and after regulation with the Portage reservoir, 42,000 wheel horse power can be maintained continuously 60 per cent. of the average year, and this is taken as the economic development for continuous 24-hour horse power, auxiliary power being used to supply deficiencies during the remaining 40 per cent. of the time. An auxiliary plant of 14,760 horse power will be required for this purpose. With a load factor of 60 per cent. the total wheel horse power development should be 70,000 horse power. Of this amount, the regular low water flow of the stream and the auxiliary power would carry 42,000 horse power, and 28,000 horse power would be the maximum draft upon the por dage which under the 242 feet head would require 1,273 cubic feet per second. The water withdrawn from the pond and added to it again each 24 hours on the basis of the load curves of the Rochester Railway and Light Company would be 20,800,000 cubic feet.

Power Value of Regulated Flow.— The diagram on Plate 13 shows the power value of the regulated flow in the river to be derived from 13.5 billion cubic feet storage in the proposed Portage reservoir provided the storage is utilized as proposed in a preceding section of this report. (Water power surveys. Office studies.)

By referring to this diagram it will be seen that one-quarter of all the water power with regulated flow and present wheel installation capacity at Rochester will be derived from stored water (blue area), that without regulation the present installation can be operated at its full capacity for only 58 per cent of the time and diminishes to a minimum of 7,500 horse power. Similarly the amount of energy necessary on the average from auxiliary power, is shown (the green area). The intercept on the 100 per cent. ordinate between the "Present-Installation" line and "Regulated-flow-of-river" curve measures the horse power capacity of auxiliary apparatus which on the diagram is about 3,000 horse power, required to maintain

continuously the full power output equal to the present wheel capacity.

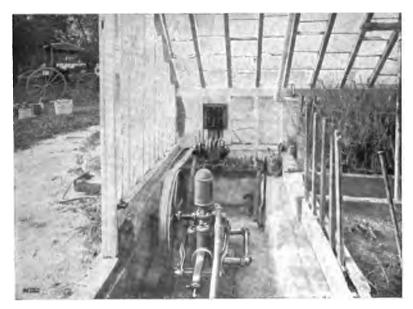
The diagram gives also a very clear indication of what will be the limit of economic development. It is near the point where the regulated-flow curve takes the sharp downward bend. As the installation capacity increases above that amount, the percentage of time that further capacity can be used rapidly diminishes. On the Genesee the economic limit of development for steady 24-hour power after regulation will be about 38,000 horse power on 228-feet head. Such a development would run 24 hours per day 66 per cent. of the time, or 8 months per year on the average. With such a development the energy furnished by the natural flow each year would be 28,000 horse power years, that from stored water 7,500 horse power years, while 2,500 horse power years would have to come from some auxiliary source.

The diagram also brings out the fact quite forcibly that full economic advantages of the stream cannot be secured even after regulation without auxiliary power. Indeed, the Rochester diagram shows that a small auxiliary plant will render more additional energy available from the stream flow after regulation than the same amount of auxiliary capacity would render available before regulation; i. e., after regulation auxiliary power is more essential to best economic results than before regulation.

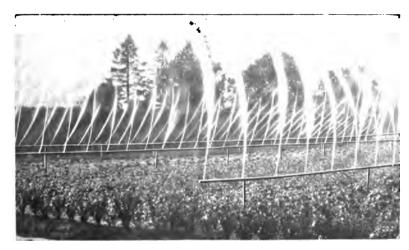
All the above is based on a steady 24-hour use of the power; i. e., a load factor of 100 per cent. The general conclusions are not, however, affected by a smaller load factor. Where there is pondage, a low load factor simply permits of a larger economic installation. Thus on the Genesee at Rochester, with a load factor of 62 per cent., the economic development would be about 62,000 horse power on 228 feet of head.

Demand for Power at Rochester.— The rapid growth of the city makes a rapidly expanding market for power as Rochester is largely a manufacturing city. Cheap and continuous power is a great incentive to rapid growth in population and conversely a rapid growth creates a demand for cheap power. In addition to the large amount of power derived from the Genesee river, there is 7,000 horse power of Niagara power now purchased in Rochester.

Plate 14



IRRIGATION AT IRONDEQUOIT, N. Y. Motor Driven Pumps



IRRIGATION AT IRONDEQUOIT, N. Y. Method of Spraying



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SMALL WATER POWERS.

Investigations have been made this year with a view to ascertaining whether or not there would be any advantage to the agricultural interests of the State to have the small streams regulated by the construction of storage reservoirs for the purpose of developing hydro-electric powers, or for the irrigation of farm lands for raising various fruits and market vegetables.

There are in the State of New York a number of interesting small power developments where a farmer has constructed a dam on the little brook flowing through his lands, leading the water to a small power house where electricity is generated for use about the farm for lighting the house and other buildings, for pumping water, or operating the dairy and agricultural machinery, and operating churns, washing machines, and other household machinery. One interesting case of this kind is at Bolton Landing on the shore of Lake George, and another is at Oriskany Falls, where a most complete untilization of power of the small streams has been accomplished. A number of these small plants have been visited by Mr. D. R. Cooper, whose report on this branch of our investigations is submitted in full.

IRRIGATION.

A most interesting example of irrigation is found at Irondequoit, near the city of Rochester, at which place water is obtained from underground sources and forced through pipes about the premises with a force pump operated by an electric motor, the current being taken from an electric light company, during the hours of the day when the demand for lighting and power is not as great as at other times.

In this plant, illustrated on plate 14, the water is pumped into a system of sprinkler pipes about two or three feet above the ground and is sprayed over the vegetables and berries with the result that an eminently satisfactory increase in the value of the crop has been realized. In addition to the test with vegetable beds, a peach orchard has been irrigated by open ditches with the result that the fruit has been more abundant than in previous years and a better price obtained for it.

It is believed that there is a large field in this State for the development of irrigation systems for the improvement of farm lands which now suffer greatly from drought in the summer season, and a much greater opportunity for the development of small water powers, thus taking advantage of small streams and making them serve the farmer with light, heat and power. But this is a matter for private enterprise and we believe that when the possibilities are realized advantage will be taken of them.

HYDROGRAPHIC WORK.

The stream gaging and rainfall observation stations described in our report of 1909 have been maintained as usual and eight new stream gaging stations and ten rain gaging stations have been established. Since the first of May, 1910, the hydrographic work has been consolidated and improved by bringing both branches under one supervising head in accordance with an agreement made with the United States Geological Survey and the United States Weather Bureau, whereby Mr. C. C. Covert, District Engineer, United States Geological Survey, should have direct charge of all stream gaging and rain gaging stations being maintained in cooperation with these Departments. Mr. Covert's headquarters having been established in Albany, this plan has put us in closer touch with his department and has expedited the work and the receipt of results from the various records.

Considerable time and expense has been devoted to the establishment of two high grade stream gaging stations, one on the Sacandaga near Hadley, and the other on the Genesee river at St. Helena. These two stations have been equipped with a cable-way for gaging, and with automatic self-recording instruments for keeping continuous records of the rise and fall of the river. On the Sacandaga, the site for the station having been selected with great care, the boulders and rough places in the river bed were removed by blasting so as to obtain as nearly as possible a smooth section through which the water would flow without obstruction, and produce conditions as nearly ideal as possible for stream gaging. A concrete well was constructed on the bank covered with a shelter house, in which has been installed the self-recording instruments and gages. This station was completed early

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in November and promises to furnish more accurate records and results than has heretofore been possible on the Sacandaga river. The station established on the Genesee river is prepared in the same manner as that on the Sacandaga, and the same class of records is anticipated from this station.

These two new stations will prove of great value in the event of the construction of storage reservoirs on the respective streams, because with them it will be possible to determine the normal flow of the stream previous to the creation of the reservoirs and thereafter to determine with a high degree of accuracy the amount of water being discharged from the storage at any time. Herewith I submit the report of Mr. C. C. Covert, District Engineer, United States Geological Survey, in which will be found a complete description of the new gaging stations, and all other work accomplished during the year in that branch of our investigation.

In response to an invitation from the director of the United States Geological Survey at Washington, your secretary and consulting engineer attended a conference held in Washington on May 31st and June 1st, for the consideration of matters relating to co-operation between the State and Federal departments and interstate co-operation in matters relating to stream gaging, rain gaging and other scientific matters of mutual interest. This conference proved of great interest and profit, and much valuable information was obtained for our use as a result of our attendance upon it.

A revised rainfall map of the State (plate 15) has been prepared from all available long time records, upon which is shown the lines and zones of equal rainfall. The mean annual dependable precipitation for the state is 38 inches. The red and green coloring on the map indicate the territories in which the annual precipitation is below and above the mean respectively.

RECOMMENDATIONS.

For the work of the Engineering Bureau during the coming year, I would respectfully recommend that the survey be completed in the Sacandaga reservoir basin during the winter months while it is possible for the men to work over the big swamp with safety on the ice. During the summer months it is practically impossible to make a survey in the Big Vly owing to the saturated condition of the ground and the rank growth of marsh grass and brush. During the winter when the ground is frozen sufficiently hard to permit, the parties can travel over the territory and the survey can be made at a great saving in cost and time. These surveys of the property lines and various farm parcels will be essential in the event of proceeding with the improvement of the Hudson river by the construction of the Sacandaga reservoir either under the present statutes or one hereafter enacted.

Studies and surveys should be continued on the Black river to complete the work undertaken in this basin, and further surveys made upon one or two other streams such as the East and West Canada creeks and the Oswegatchie river.

Power surveys similar to those made this year on the Hudson and Genesee rivers should be made on the principal power streams of the state, including the Black, Oswego, Salmon, Oswegatchie, Raquette, St. Regis rivers and East and West Canada creeks.

The studies of the present year indicate that a small amount of money can be profitably expended in further investigations on Owasco and Canandaigua lakes for the partial regulation of the Oswego river. Further studies and some surveys should be made with regard to the storage and power possibilities on the small streams.

The hydrographic work should be continued and enlarged as far as possible. This work being done in cooperation with the United States Geological Survey has been demonstrated to be of great value during the past three years, and as it is the foundation data upon which all water storage and water power development studies must be based the work should be continued without interruption in the same manner and with the high degree of accuracy as now prevails.

Respectfully submitted,

WALTER McCULLOH,

Consulting Engineer.

WATER POWER

FOR THE

FARM AND COUNTRY HOME

BY DAVID R. COOPER

Engineer-Secretary to the Commission



Plate 16



SCENIC CASCADE.





WATER POWER FOR THE FARM AND COUNTRY HOME

By DAVID R. COOPER Engineer-Secretary to the Commission

In the course of its general investigations of the water powers of the State, the Water Supply Commission has heretofore confined its attention to the possibilities for large developments, and the regulation of the flow of rivers and large creeks. No previous or general investigation of small creeks and brooks and their power possibilities has been made, not because they were considered unimportant, but because the Commission believes that if the State decides to take an active part in the regulation of the flow of streams and the development and conservation of water powers, it should confine its first activities to the larger units, leaving the smaller opportunities for later examination and for private and individual development. However, no comprehensive system of conservation can meet with universal favor unless it contemplates the prevention of waste, great or small, and wherever found.

Accordingly the Commission desires to call attention to the valuable power which is now running to waste in thousands of small creeks and brooks in all sections of the State. Many of these minor streams present possibilities for small individual developments of power sufficient to supply all the requirements of the owner at a comparatively small cost. Numerous farms in the State have on them brooks or creeks capable of supplying power sufficient to furnish electric light for all the buildings. Others would also furnish power enough to drive a feed grinder, a churn or cream separator, or to run a wood saw, sewing machine or other machines and implements, requiring a small amount of power for their operation. In short, there are numerous small streams now tumbling over ledges in barnyards or pastures, whose wasted energy might readily be transformed and applied to useful work by the installation of small

and inexpensive water power plants. If the power of more of these were developed and substituted for manual labor a great saving of time and energy would be accomplished and financial profit would result.

After the initial expense of installing the plant is paid, the cost of a small water power is inconsiderable, the plant requiring little personal attention and small expense for supplies and repairs. However, while the power of some streams may be developed at an amazingly small cost, in other instances the cost may be prohibitive. In this connection, one fact that is perhaps not fully appreciated is that the power of a waterfall is comparatively permanent, only its rate of availability being limited. While the stream may shrink in the dry summer and fall, it is quite certain to swell again in the spring and to continue the process, year after year as the source of supply is continually renewed. But the power which might have been, but was not developed in the year 1910, cannot be reclaimed in 1911 or ever after. Much of the power that is wasted by inequality of the flow of the stream may be saved by conservation through water storage; but this sometimes involves a large outlay and therefore, generally speaking, the fullest value of the power of a small stream can best be obtained by using the stream as it runs. or at best after temporary storage behind inexpensive dams.

The Water Supply Commission believes that the possibilities for small water powers should be pointed out to the people of the State in order that there may be a better realization of the usefulness and value of this remarkable natural resource and that the farmers and residents of rural districts may take advantage of the opportunities to conserve and utilize them. It is believed that some facts relating to the utility of power in general and small water powers in particular, together with descriptions of some typical small water power developments that are now in actual operation, and brief notes on the fundamental principles of such a development will suffice to bring the subject forcibly to the attention of those most interested, and furnish at least a beginning for observations in this comparatively new field. A more general utilization of this source of power would result in a saving of much energy now secured from coal, wood and other exhaustible producers of power.

Accordingly the following discussion of the many and varied uses for power on the modern farm, together with descriptions of power plants now in use and notes on developing a small water power are submitted in the hope that they may be of interest and service to those who have chosen farming for their livelihood or pleasure, and that they may assist in a consideration as to whether or not it may be worth while to develop the power of any particular stream. It seems that some practical conservation of small water powers should result.

USES FOR POWER ON THE FARM.

The impossibility of securing a sufficient number of capable and satisfactory farm hands in these days, when the majority of young men are turning to the populous centers for their livelihood, is perhaps the most compelling reason why machines which can be substituted for manual labor are a decided advantage to the up-to-date Their adoption as a part of the permanent equipment for the farm renders their owner comparatively independent of the problem of supply and demand for farm labor, the solution of which problem is an important factor in determining the success or failure of the farmer who disposes of his produce in open market. This condition is supplemented by a commendable tendency for farmers to live better, to place the home life of the farm on a higher plane, and to make farming a means of pleasurable livelihood rather than to content themselves with merely eking out a bare subsistence from the products of the soil. These conditions, together with the greatly improved quality of illumination and convenience which electricity affords, are creating a growing demand for a reliable and reasonably economical source of energy with which to supply both light and power on the larger estates and farms. That electric light is much cleaner and more convenient than kerosene lamps must, of course, be admitted by all. It must also be admitted that a kerosene lamp of any considerable illuminating power has also certain heating propensities which render it an unpleasant companion on a warm summer evening. However, when it comes to a consideration of mere dollars and cents, there seems to be a widespread belief that kerosene, as a source of illumination, is cheaper than electricity. Statements to this effect are too often allowed to go uncontradicted, and too many people accept this view without taking the trouble to investigate.

It is a comparatively simple matter to compare the cost of the two kinds of light, knowing as we do exactly how much current an electric lamp, of a certain filament and candle power, will consume. Such a comparison will frequently result in a choice of electricity as the cheaper light. In many cases the selection of electricity to supplant kerosene lamps would result in no considerable saving of money, but would do away with considerable inconvenience and furnish much better illumination. If cost is the controlling consideration, the comparison cannot always be so much in favor of electricity. An important consideration, often overlooked, is that with electric lights the interiors of living rooms do not require such frequent papering or refinishing as they would require with kerosene illumination.

However, the convenience and cleanliness of electricity are fairly well known and appreciated, but the means by which electric currents may be generated economically, and by which this form of energy may be applied to bring about sufficient returns, financial and otherwise, to warrant the installation of an isolated plant for a farm or country home, are not so generally understood.

Electric current may be generated by means of a dynamo or generator with any kind of a power producing plant. All that the dynamo requires to enable it to produce electric current is power of some kind that may be applied in such manner and quantity as will cause the armature, or "interior core" of the machine to rotate at a sufficiently high rate of speed. There are various kinds of power generators which will perform this work satisfactorily for isolated plants. Within the last few years the small internal combustion engine, supplemented by the electric storage battery, for stationary service, have been so much improved and simplified as to cause them to compare very favorably with the better known types of power producing apparatus in first cost and in reliability of operation. The extreme simplicity of both this type of engine and of the storage battery, together with the great economy in fuel consumption of these engines, the low price of fuel, and the efficiency of the battery as a device for storing the energy and delivering it in the form of electric current when

needed and in the quantity required, result in a low operating cost. The advent of tax-free alcohol into the field of available fuels for use in internal combustion engines and the growing demand for this class of fuel, indicate that it will become, in time, a strong competitor for kerosene and gasolene. At present, gasolene is the most generally used fuel for engines of this type and small sized gas engines are now manufactured by many firms.

Steam power is probably the best understood of all classes of power. In many cases, especially where the fuel is very cheap, this is the best power for a farmer to have. Steam power plants as well as gasolene, kerosene and alcohol plants all require personal attendance during operation and necessitate more or less frequent applications of fuel. Wind power is also a source of energy, which may well be considered by the farmer who needs a small amount of power.

Perhaps the most promising source of power for farmers in New York State is the power that may be developed from falling water. This kind of a power plant requires comparatively little personal attention while in operation, and needs no replenishing of fuel except such as nature herself provides in the flowing brook. Not only are there many of these power sites that are undeveloped as yet, but there are many others which have been developed at some previous time and have recently been allowed to fall into disuse for various reasons. Many old saw mills were abandoned when the surrounding hills were all lumbered off. A small investment would enable many such old powers to be revived and applied to some useful purpose. Such a water power plant could frequently be made to serve the owner or a group of users of electric current at very small first cost for each individual, and at an operating cost which would be inconsiderable.

It should be borne in mind, however, that much depends on the choice of the best power for any particular purpose and a careful consideration of what is needed, and the conditions under which the power must be supplied, is essential to insure satisfaction with a power plant. In any particular instance a manufacturer of small water wheels will cheerfully submit an estimate for a water power plant, while the makers of steam and gasolene engines will quite as readily furnish any information, to be based on data furnished by the intending purchaser.

The extent of the applications of power to practical purposes on the farm is very broad. While perhaps electric lighting is the use most frequently thought of, it is, however, in the application of electric current or power to the operation of labor saving devices that the greatest gain is to be derived on the large farm or country place. Feed grinders, root cutters, fodder cutters, fanning mills, grindstones, circular saws, corn shellers, drill presses, ensilage cutters and elevators, horse clippers, milking machines, grain separators, threshing machines, cream separators, churns, vacuum cleaners, ice cream freezers, dough mixers, feed mixers, chicken hatchers and numerous other machines and implements operated by power, are obtainable in these days of labor saving devices. The amount of power required to operate many of these is small. The presence of a plant of sufficient capacity to operate one or two particular machines often makes it possible to use the power for many of the other purposes. The amount of work that a small amount of power will do may be judged from the following brief statements of what is actually being done with existing plants.

Six horse power will drive a grain separator and thresh 2,500 bushels of oats in ten hours.

Three horse power furnishes all power needed to make 6,000 pounds of milk into cheese in one day.

Six horse power will run a feed mill grinding 20 bushels of corn an hour.

Five horse power grinds 25 to 40 bushels of feed, or 10 to 12 bushels of ear corn an hour.

Seven horse power drives an 18-inch separator, burr mill and corn and cob crusher and corn sheller, grinding from 12 to 15 bushels of feed an hour, and 5 to 8 bushels of good fine meal.

Six horse power runs a heavy apple grater, grinding and pressing 200 to 250 bushels of apples an hour.

Five horse power will drive a 30-inch circular saw, sawing from 50 to 75 cords of stove wood from hard oak in ten hours.

Six horse power saws all the wood four men can pile in cords. Twelve horse power will drive a 50-inch circular saw, sawing 4,000 feet of oak or 5,000 feet of poplar in a day.

Ten horse power will run a 16-inch ensilage cutter and blower, and elevate the ensilage into a silo thirty feet high at the rate of seven tons per hour. One horse power will pump water from a well of ordinary depth in sufficient quantity to supply an ordinary farmhouse and all the buildings with water for all the ordinary uses.

In determining the size of power plant required in any particular instance the use requiring the largest amount of power must be considered. It follows that there will then be plenty of power for the smaller requirements. In considering a water power it should also be borne in mind that the full theoretical amount of a water power can never be realized, a certain portion being taken up in friction in the water wheel and in losses in the electric generator, transmission lines, motors, etc. The question as to how much may be made available will be discussed hereinafter.

Following are descriptions of some typical water power developments in use in this State at the present time.

FARM WATER POWER DEVELOPMENT IN ONEIDA COUNTY.

On the outskirts of the village of Oriskany Falls, in Oneida county, N. Y., is a farm of about one hundred acres, belonging to Mr. E. Burdette Miner. This community was at one time one of the principal hop raising districts of the State. Mr. Miner has been engaged in raising hops for fifty years, and raised 10,000 pounds of hops on seven acres the past season. In recent years he has divided his attention between mixed farming and dairying, keeping from twenty to twenty-five cows.

Before the installation of his water power, not the least of the irksome tasks about the farmhouse was the daily filling and cleaning of kerosene lamps and lanterns, and the wood was sawed, and the cream separator and churn in the dairy room were operated by hand. Five sons contributed in no small measure to the prompt disposal of the daily tasks. But the boys went forth into the world and acquired lines of activity and interest of their own. Only the oldest son remained to live on the farm. Another son studied electrical engineering, a third chose mechanical pursuits, a fourth became a civil engineer, and the fifth took up commercial work. After coming in touch with the outer world and the great modern achievements of science and invention, especially of a mechanical or engineering character, the boys quite naturally set their wits to work to devise some way that the daily labors of those at home might be made less burdensome.

Through the farm flows Oriskany creek, which ripples over its gravelly bed in a channel from twenty to thirty feet wide. The boys said to their father, "Why not harness the creek and make it do some of the work?" There was no precipitous fall of the creek on the farm, but the boys proposed to concentrate at least a portion of the fall by constructing a dam. This they intended to do primarily for the purpose of developing enough power to light the homestead and farm buildings with electricity and to saw the wood and do away with some of the other tiresome farm tasks.

The elder Miner was not enthusiastic at first, but was finally persuaded by the boys, who made surveys and plans for a water power development, and in October, 1905, with the assistance of three of his boys and two day laborers, Mr. Miner began the construction of a dam across the creek. This was to be no ordinary structure. The creek, while peaceful enough at most times, had a habit well known to Mr. Miner, of bursting its bounds every spring and rushing through the farm in a torrent. So the dam was built in such a way that, while it would raise the water to a certain height during periods of ordinary flow, it would not cause the floods to rise perceptibly higher than before the dam was built. Accordingly it was designed so that a part of it could be lowered at flood times to allow free passage for the swollen stream.

The bed of the stream at the site selected for the dam is composed of solidly packed gravel. It was not considered advisable to lay timbers directly on such a foundation, so a ditch about two feet deep and one and one-half feet wide was dug across the creek bed and filled with concrete, to which a heavy timber was securely bolted, to form the upstream sill for the superstructure. The downstream side was supported on a sill of heavy timber whose ends were imbedded in the concrete walls or abutments at either end of the dam and whose middle portion was supported by posts spaced six feet apart, which in turn rested on large blocks of concrete placed in the bed of the creek. This downstream sill was about two and one-half feet higher than the upstream sill. A horizontal floor of double plank extending twelve feet downstream from the upstream sill and supported by the concrete foundations under the downstream sill formed an apron for the water to fall on.

This prevents back washing under the dam. A double layer of heavy plank was then fastened on the two sills, forming a sloping face on the water side of the dam. On the upper edge of this plank-facing at the crest of the dam, are placed flash boards, one foot high and extending the full length of the dam, thirty-six feet, but divided into six sections, each six feet long. Each of these sections is hinged by the lower edge to the crest of the dam, while the upper edge is held from tipping over by chains fastened to cast iron lugs located about halfway down the planking. The chain is held in these lugs by pins which are connected by rod and chain to a capstan or spindle located at one end of the dam and are so arranged that by turning the spindle the pins will be drawn successively, thereby letting the flash boards down one at a time. The idea of this arrangement is that when a flood is rising the capstan may be turned with a heavy lever crank, winding up the chain and pulling down the flash boards, one at a time, to give more space for the flood to pass over so as to prevent the water upstream from the dam from rising too high. This plan has prevented the washing away of Mr. Miner's power house on several occasions.

The sloping face of the dam receives the direct pressure of the water and transfers it to the sills which in turn transfer it to the foundation. The reason for sloping the upstream face of the dam is that the pressure of water is always normal or perpendicular to the surface against which it presses, therefore, if the face of the dam is sloping, the pressure is downward, rather than outward as would be the case with a vertical face. This results in greater stability for the dam, due to the lessened tendency to tip over. With a dam of this type the higher the water rises against or over it, the more nearly vertical is the line of pressure, and the dam is held tightly down on its foundation instead of tending to tip over. It follows that the flatter the face of the dam the more stable it will be. Mr. Miner's dam, with the flash boards up, raised the water about four feet.

But in spite of his provision for floods, Mr. Miner did not want to be under the necessity of letting down his dam for every freshet, nor did he care to risk the damage that might result from an unusual flood, so he provided an additional permanent spillway. This

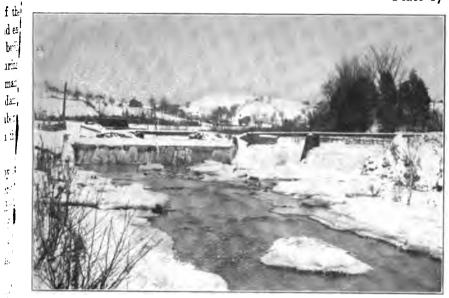
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is a simple concrete barrier or wall which flanks one end of the dam. In plan it was built at an angle with the dam proper, and extends down stream along the side of the natural bank. It was built with its crest four inches higher than the main dam, so that during periods of ordinary flow the surplus water all passes over the main dam, but as soon as the creek rises a few inches over the main dam, water begins to flow over this extra spillway, which being about forty feet long will discharge a considerable volume although the water flowing over it is only a few inches in depth.

This spillway is strengthened on the downstream end by a concrete abutment, which consists of a heavy block of concrete extending forty-two inches above the spillway. A similar abutment flanks the upstream end and also constitutes an abutment for one end of the main dam. The other end of the main dam is set against the opposite bank of the creek and is protected from washing and is strengthened by a similar concrete abutment.

It was considered desirable to place the little power house away from the main channel of the stream so an earth embankment was built extending from the downstream end of the flood spillway a distance of about sixty feet. This embankment or dyke is three and one-half feet higher than the main dam and is curved in such manner as to divert the water behind it across a low place to a safe distance from the main channel. Some excavating had to be done behind this embankment in order to secure a channel of sufficient depth to prevent the water from freezing to the bottom, and to provide a smooth channel of approach to the power This diversion of the water to one side from the main channel prevents the accumulation of debris and silt, which is a hindrance to the proper operation of a water wheel. The pool thus formed is called a "forebay" and is very quiet water. The velocity of the water flowing through it is so slight that it will not carry much debris.

At the downstream end of the forebay the diverting embankment approaches a steep bank. At this point Mr. Miner built a small power house. Under the power house is the wheel-box which consists of a box-like compartment having one side open to the forebay. This opening is covered with a coarse screen-rack to prevent leaves or other debris from entering the wheel, but the water



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DAM OF E. B. MINER, ORISKANY FALLS. N. Y. Main dam at left; flood spillway at right.



FARM POWER HOUSE ON ORISKANY CREEK. Dam in left background; tail-race in right foreground.



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flows through it readily. In the wheel-box a water wheel of the type known as a turbine, was placed. This revolves on a vertical shaft or axle, which is guided by bearings in a metal case surrounding the wheel and resting on the bottom of the box-like com-The wheel case is open at the bottom to allow the free escape of the water after it has passed through the wheel. The construction of the turbine is such that the pressure of the water on the curved vanes, causes the wheel to revolve, just as the pressure of wind causes a windmill to revolve. must have a free escape from the opening in the bottom of the wheel case and wheel-pit, and to provide for this a channel called a "tail-race," was excavated to carry the water rapidly back to the creek. Natural conditions were favorable here and a tailrace joining the main channel about 100 feet below the power house was constructed with little difficulty. At the point where the tail-race joins the creek the elevation is two feet lower than the power house so there is little tendency for water to back up from the creek into the tail-race. There is a certain amount of backwater during freshets but the increased height of the water in the forebay at such times partially offsets it.

The vertical shaft of the turbine extends up through and about two feet above the floor near one end of the power house, where it is supported on ball bearings which enable it to be revolved with very little friction.

At the other end of the power house which is twelve feet by sixteen feet in plan and seven feet high to the eaves, was placed an electric generator or dynamo, rated at 12½ kilowatts, which is equivalent to about 17 horse power. This machine is intended to operate at about 1,100 revolutions per minute. The water wheel under the pressure of about six feet would not revolve at such a high rate of speed. It was, therefore, impracticable to connect the generator shaft directly to the water wheel shaft and it became necessary to magnify the revolutions by connecting the two shafts by belt, using different sized pulleys. A large wooden pulley seventy-six inches in diameter was keyed on the end of the water wheel shaft. A much smaller pulley, about eight inches in diameter, was placed on the driving shaft of the generator. A leather belt connects the two and since the wheel shaft is vertical

and the generator shaft is horizontal it is necessary to pass the belt over an intermediate pulley, or "idler." This idler is set with its axis at an angle with both the horizontal and vertical so that the transition of the belt from the horizontal to vertical is made gradually. Since the driving pulley on the generator shaft is so much smaller than the pulley on the wheel shaft, for every revolution of the wheel shaft there are about nine revolutions of the generator shaft.

The amount of power which this equipment will generate depends to a considerable extent upon the amount of water flowing. Oriskany creek at this point has a tributary drainage area of about fourteen square miles and the flow required to drive the turbine to full capacity is about 2,900 cubic feet per minute. This volume is probably available during most of the year but is not available in the driest seasons at which times the flow is probably reduced to about 600 cubic feet per minute. The water wheel probably has an efficiency of about 80 per cent., that is, it will probably develop about 80 per cent. of the theoretical energy of the falling water. The remainder is lost in friction in the wheel-box at the entrance to the wheel and in the velocity still remaining in the water after it leaves the wheel. Five per cent. of the power generated on the wheel shaft is probably lost by friction of the belting so that about 76 per cent. of the theoretical power of the water is probably delivered to the shaft of the generator.

Mr. Miner realized that there would be times when he would not require all or any of the power which would be produced. At the same time the pond formed by the dam was not large enough to store any considerable amount of water and he had all the power he would require at any one time, so it was not considered necessary to provide storage batteries to store the electricity. On the other hand he did not wish to be compelled to turn the water on and off at frequent intervals. Therefore, it was decided to provide for the plant to run continuously. This necessitated devising some means to consume the electric current when not in use. A series of resistance coils were mounted on a frame work in the power house, and connected with the generator. When the supply of electric current exceeds the demand, a small electric device automatically throws one or more of these coils into the circuit, and the sur-

plus current is consumed in friction and converted into heat by the resistance of the coils. By means of this arrangement it was planned to run the plant continuously so that whenever electric current was wanted it could be had simply by turning a switch at the house or barns.

The power plant, including the dam and all the features thus far described, was completed and in operation before Christmas of the year in which the construction was begun.

We have thus far seen how Mr. Miner developed his water power and transformed it into electricity. It remains to see how he gets it to his house and farm buildings and how he uses it after he gets it there.

The power house is situated about 1,700 feet from the house, where the electric current was most wanted. This necessitated the construction of a transmission line. For this purpose a double line of bare aluminum wire was stretched on a line of poles about twenty feet high and about one hundred feet apart. The poles are provided with ordinary crossarms at the top on which are mounted the insulators carrying the wires. As the transmission line leaves the power house it crosses a highway and runs in a perfectly straight line to the house. Over the highway insulated wires were used as a safety precaution but bare aluminum wire was used for the remainder because it was cheaper.

The buildings are all in a cluster and a branch from the transmission line runs into each one where the current is used. All the wires which are inside of any of the buildings or are close to the woodwork, are covered with insulation and where concealed are further protected by flexible metallic conduits or pipes.

The first actual use of this hydro-electric power was for lighting. The house was illuminated with electric lights, as were also the barn and other buildings, there being ultimately about seventy sixteen candle-power lamps in use. Even the pig sty has its electric light and there is no more groping in the dark anywhere about the Miner farm buildings.

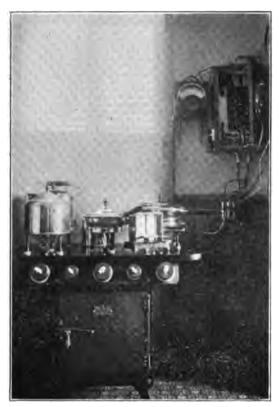
But there was more power in the creek than was necessary to run the electric lights. A circular saw was brought into use, belted to a motor, and the supply of fire wood was cut in a fraction of the time previously required. The same motor is used to drive a lathe, drill, grinder and buffer in a machine shop which the Miner boys built and equipped This motor is belted to a countershaft from which additional machine tools can be driven. One of the Miner boys has developed this machine shop as a combined means of pleasure and profit. In addition to a considerable amount of experimental machine work, he does all the farm repairs and a considerable amount of machine work for neighboring knitting mills, as well as general and automobile repair work, all of which has been made possible by the harnessing of the creek.

Another motor, two horse power, driven by the electric current, is belted to a vacuum pump which is connected with a 1-inch pipe running to the house and the barn. In the house there are two taps, one on each floor, to which the hose of a vacuum cleaner may be attached, and Oriskany creek does the rest; the floors are cleaned in the most modern, sanitary and thorough manner. In the barn the pipe from the vacuum pump runs above the cow stanchions with a tap at alternate stanchions. The tubes of the milking machines are attached and the creek milks twenty or twenty-five cows twice each day.

In the dairy room is a one-half horse power motor, which may be belted to the cream separator or churn, and on the hot summer days it is frequently belted to the ice cream freezer. An ingenious float device in the separator turns off the power when the cream is all separated from the milk and trips a can of clear water into the heavy revolving bowl of the separator, which still retains enough momentum to rinse itself thoroughly before coming to rest.

In a similar manner other applications of the power have followed from time to time and one at a time most of the hand cranks on the Miner farm have been relegated to the scrap heap; even the grindstone is operated by a rope belt run from the little motor in the dairy out through the door to an adjoining compartment.

In the Miner residence are five electrical heaters, which Mr. Miner states will raise the temperature to 75 degrees when it is zero outside. Since these heaters were installed there has not been much use for the wood saw. There are also in the house some electric fans which stir up a breeze on the hot days. An electric ventilator fan in the attic insures cool sleeping rooms on hot summer nights and good ventilation at all times. In the



ELECTRIC COOKING OUTFIT, E. B. MINER'S HOME.



MODERN APPLICATION OF HYDRO-ELECTRIC POWER; VACUUM MILKING MACHINES.

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kitchen the Miners cook for a family of from five to ten with an electric range, and iron with an electric iron, attached by a cord to an ordinary electric lamp socket. A small motor operates the egg beater and cream whipper. Another small motor drives the sewing machine.

The little motor in the dairy room also drives a single acting plunger pump which forces water up to a galvanzed iron tank in the attic of the house, whence water is piped and furnished by gravity to the bathroom and kitchen. An electric heater in the kitchen heats the water for the bath and kitchen.

Other miscellaneous uses are made of the never failing power of the creek, such as filling the silo, and the power plant requires practically no attention. Self-oiling devices on the water wheel and generator and the use of the resistance coils to consume superfluous electric current obviate the necessity for attention, except to fill the oil cups every few weeks. Practically no trouble has been experienced in the operation, the only interruption so far being due to the formation of anchor ice in the forebay and screen racks, which causes a little trouble on extremely cold days. The water wheel is run continuously night and day, summer and winter, and electric light or current is always available at the touch of a button or by throwing a switch.

As to the cost of his plant Mr. Miner would give no figures. His motto seems to be "Not how cheap, but how good?" and he states that it would require several times the cost to induce him to give up his water power plant. The cost of reproducing his power plant, including the dam, power house, water wheel, generator and transmission line, is estimated at about \$1,800.

SUMMER HOME POWER PLANT, NORTHWEST BAY, LAKE GEORGE.

Among the attractive summer homes on the shores of Lake George, is that of Mr. Stephen Loines of Brooklyn, located at the upper end of Northwest bay about four miles above Bolton Landing. On his property there was a small lake known as Wing pond, having an area of about seven acres and situated at an elevation of about 180 feet above Lake George. The outlet was a small brook which runs through Mr. Loines' property and flows into Northwest bay.

In the summer of 1902, Mr. Loines built a dam across the outlet of Wing pond, raising its surface about two feet. He ran a galvanized iron pipe line from the dam down the side of the hill and along the brook. It was four inches in diameter for a short distance, then reduced to three inches and finally to two inches, and was about 1,200 feet long in all, with a fall of about 110 feet. A 24-inch water wheel of the impulse type was installed in a small power house to which the pipe line was run. The water wheel developed about three horse power and was belted to an electric generator.

The power was found to be insufficient to supply Mr. Loines' needs at that time. He desired to burn thirty-five 16-candle power carbon filament lamps and to charge a 40-cell battery for an electric launch.

Accordingly, in the fall of 1908, Mr. Loines raised his dam two feet higher and installed a 6-inch spiral riveted steel pipe line running from the dam down a gulley on the surface of the ground, for about 1,600 feet, to a point a short distance from the place where the creek flows into Lake George. At this point he built a small power house and installed a 24-inch water wheel of the impulse type. This wheel operates under a head of 165 feet and is directly connected by a shaft to a 6½-kilowatt generator which operates at 500 revolutions per minute. This generator supplies a 60-cell house battery (45 lamps), an 84-cell battery for a 35-foot cabin launch, a 48-cell battery for a 20-foot open launch and a 40-cell battery for an electric roadster, all of which are in pretty continuous use from about the first of June to the first of November of each year.

As this new development superseded the older one and proved entirely adequate for the needs of Mr. Loines' country place, the old development was made over so that it could be utilized for sawing fire wood to supply the superintendent's cottage and the other buildings during the winter. A countershaft was erected on the wall of the old power house, which is a building 7 feet by 10 feet in plan and about 8 feet high. This countershaft has three counterpulleys, by means of which the speed of the water wheel may be doubled or trebled. For the purpose of sawing fire wood a leather belt is placed on one of the pulleys of the countershaft and run

Plate 19



STEPHEN LOINES' POWER HOUSE, NORTHWEST BAY, LAKE GEORGE. At left, 4-in. water pipe; at right, transmission line connection.



POWER TRANSMISSION LINE, NORTHWEST BAY, LAKE GEORGE.



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through a small aperture in the side of the power house to the driving pulley of a circular saw which stands on a small porch at one end of the power house building.

Mr. Loines' superintendent stated that by operating the saw continuously for eight hours it would be possible to saw twelve cords of wood, which he estimated to be sufficient to supply his cottage and such other of the buildings as need wood, for the entire winter. This illustrates very aptly the large amount of work that a small power is capable of doing in a short time.

In addition to lighting his house and buildings by means of the power developed at his new power house, Mr. Loines also has a rather unusual application of power on his summer place. He is an enthusiastic student of astronomy and has built a small but elaborately equipped observatory on the hillside above the cottage. The observatory is so constructed that the roof can be removed entirely from the building to a support at the back of the observatory. The roof is mounted on wheels and Mr. Loines uses his electric power to do the work of moving the roof when he wishes to make astronomical observations with his telescope. This is accomplished by means of a small 1½ horse power motor which operates at 1,275 revolutions per minute and is connected by belt to a countershaft, which in turn is connected by a worm gear and a chain drive to the carriage on which the roof is supported. In this manner the roof may be moved the required distance in two or three minutes by simply throwing the switch which is inside the observatory building.

Mr. Loines' new power house is a stone masonry building, the masonry being uncoursed rubble constructed in a very artistic and attractive manner. The building is $9\frac{1}{2}$ feet by $15\frac{1}{2}$ feet in plan and is about 9 feet high to the eaves. It has a concrete foundation and the floor is of first class concrete. A concrete foundation about 3 feet by 5 feet provides a permanent support for the water motor and the generator. This foundation projects six inches above the level of the concrete floor. On one end of the foundation stands the water wheel, there being an opening about 8 inches by 18 inches through the concrete base under the water motor to carry off the water after it has passed through the wheel. The supply pipe for the water wheel enters the side of the building on a level about

one foot above the floor. Just inside the pipe reduces to a diameter of about two and one-half inches and is fitted with a gate valve by means of which the water may be turned on or off. The nozzle of the water wheel is also equipped with an adjusting device by means of which the size of the jet issuing from the nozzle may be varied in order to secure various speeds or the maximum efficiency of the water wheel. The setting required to give the desired speed is determined by experiment by the operator.

FARM POWER DEVELOPMENT IN SCHOHARIE COUNTY.

At the entrance to the driveway approach to the farm house of Jared Van Wagenen, Jr., at Lawyersville, Schoharie county, N. Y., stand two large stone gateway posts. On the cap stone of one of these posts is engraved "Agriculture the Oldest Occupation" and on the other "Agriculture the Greatest Science." In keeping with the latter sentiment, Mr. Van Wagenen has conducted his agricultural operations in such a manner that he is looked upon as one of the most scientific and progressive agriculturists in the State. He takes an active interest in such affairs as farmers' institutes and is considered an authority on the science of agriculture. His farm and buildings are equipped with the most modern conveniences and labor saving devices.

There is a small stream which runs through the farm and flows into the Cobleskill. This stream is so small that one may easily step across it in the summer time. About half a mile from the farm house is an old mill dam which forms a pond with an area of more than an acre. The dam was built long ago when small saw mills dotted that section of the State. The timber having been practically all cut off, this mill, along with hundreds of others, was abandoned. Mr. Van Wagenen conceived the idea of harnessing its wasting energy and making it do some of his farm work for him. The story of how he accomplished this is best given in his own words, as follows:

"About eight years ago I began to figure on how to get this power to the house where it could do a little work. My first thought was to carry it there by belt cables, but figures proved that the friction would eat up the five horse power available. Electric power, easily transmitted with little loss, was the only solution.

I talked with many who understood electricity and its engineering features and most of them laughed at the idea of such a small installation. Had I wanted to construct a million dollar plant there would have been whole libraries of advice; but a small plant to run entirely alone and be controlled by a seven-hundred-foot wire was evidently a novelty. After a good deal of studying and feeling my way the plans were made and the work begun.

"The stream being so small, the most rigid economy of water had to be observed, so I installed a nine-inch upright turbine in an upright wooden case, building the case myself, where it would get the most benefit of the fifteen-foot head. This turbine furnishing about five horse power. I belted to a three-kilowatt or fourhorse power, one hundred and twenty-five volt direct current generator, which would easily take care of seventy-five metal filament incandescent lamps. I next installed a water wheel governor to insure a steady flow of electricity. It took about seventy-four hundred feet of weather proof copper wire, strung on wooden poles which were cut on the farm, to carry the electricity to my home and the farm buildings and to the house of a neighbor. As it is more than half a mile from the house to the plant it is out of the question to go there every night and morning to stop and start the machinery. Of course it is possible to let this plant run night and day during the wet season but in dry times it is best to save the water when the power is not needed. A neighbor living about seven hundred feet from the power station kindly starts and stops the machinery with a wire stationed at his bedroom window. This wire controls a valve and counterweight. At five o'clock in the morning he pulls the wire and the lights come on and at a certain hour of the night he releases the wire and they go out. In payment for this service I light his house and barns free of charge.

"Our maintenance charges are very small; almost negligible. I think our water wheel behaves better every year. Carbon brushes for the generator last a long while and oil is a very small item. Each year I am improving the plant, and very soon I expect to install a motor-driven washing machine and wringer to prepare the clothes for the electric iron, and to put a vacuum cleaning outfit in the house.

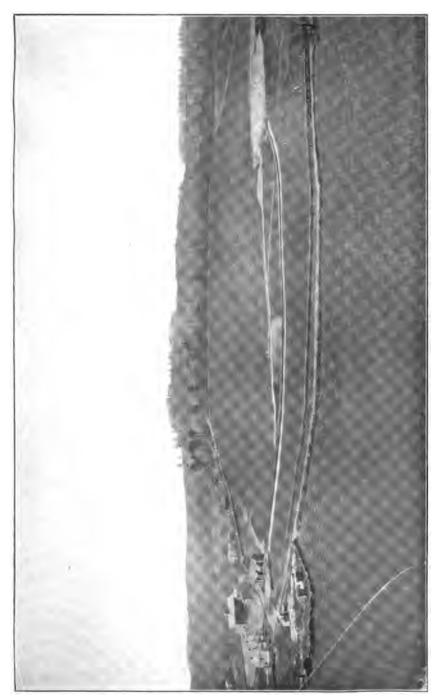
"Although I consider the cost of our plant about \$500, it was installed under the most rigid economy in every respect and mainly by my own hands. The dam was already built and needed only some trifling repairs. The gate control is my own get-up, and while the cost is trifling it took considerable study to get it to work right. I did most of the house wiring, using concealed knob and tube for the living-rooms of the house; moulding and open wiring for the other rooms and for the barns. This material cost me about \$40. Of course, I do not in any instance figure in my own labor as the work was all done at odd times."

This small power development using the dam already built cost Mr. Van Wagenen about \$500 as follows:

Dynamo, 3 k.w. (second hand)	\$ 50	00
Waterwheel, 9 k.w. (naked wheel)	55	00
Governor, (new)	75	00
Wire, (7,400 feet)	210	00
Labor, (installing water wheel)	40	00
Fixtures, (lamps and the like)	38	00
One small motor, 2 h.p. (new)	50	00
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Total	\$ 518	00

The plant furnishes power sufficient to light the farm house and all of the buildings with electricity as well as those of the neighbor who turns the water on and off. In the dairy a small electric motor of about three horse power, actuated by the electric current, drives the cream separator and also furnishes power for running the grindstone, feed cutters, hay fork and fanning mill, in addition to which the power is also used to milk the cows and cut the ensilage and to do numerous other bits of work about the place. Mr. Van Wagenen states that his water power does work equivalent to that of a hired man the year round and does away with numerous chores and laborious duties about the place.

The arrangement which Mr. Van Wagenen devised to turn on the water at his plant and to shut it off again is unique and interesting. It consists of a triangular frame lever about two feet wide and seven feet high, hinged at one of the bottom corners. The



PARM POWER DEVELOPMENT OF JOHN T. MCDONALD, DELAWARE CO., N. Y.





other bottom corner is connected to a flap gate which fits over the feed pipe for the water wheel. At the top are fastened two wires, one of which runs to the house of Mr. Van Wagenen's accommodating neighbor, and the other runs over a pulley and has a counterweight attached to it. When the water is to be turned on, the neighbor pulls the wire and the gate is raised by the leverage of the frame; when the water is to be shut off, he releases the wire and the counterweight pulls the lever back, allowing the gate to fall in place again.

OTHER SMALL POWER DEVELOPMENTS.

Mr. John T. McDonald, who has a farm about five miles from Delhi, Delaware county, N. Y., some ten years ago began making good use of a power development from a small stream on his farm. He lights his house and buildings, runs saws, grinders and various machines in a little shop on rainy days and in the winter. His dam was made from stone and earth from the nearby fields and cost very little. It forms a pond covering when full, about four and one-half acres of land. The pond is well stocked with trout and other fish and each winter Mr. McDonald cuts about 500 tons of Mr. McDonald turns on the water at his dam by means of an electric switch at the house and regulates the voltage also in a similar manner. From the pond the water is led through a hydraulic race or canal about 900 feet long to one of the farm buildings where the water wheels are installed. The head, or fall, at this point is about 15 feet and there are three water wheels of the turbine type; one that develops twenty-five horse power, another that develops six horse power and a third that develops about three horse power. The large wheel is used to run a saw mill and feed mill. The six horse power wheel drives an electric generator or dynamo which furnishes the electric lights, and also electricity for driving the small motors about the place. three-horse-power wheel runs the small saws, machine tools, etc., in Mr. McDonald's shop.

A few miles east from Mr. Van Wagenen's farm in Schoharie county is another small power development owned by Mr. Frank Casper. He has installed two water wheels on a small creek and uses the power from them to drive the machinery in a table and

furniture factory. He has another small water wheel of the turbine type driving a little dynamo which generates electricity for electric light. Mr. Casper lights his factory buildings, his home, a neighboring church and the main street in the village with electricity from this little dynamo. An ingenious device of his own invention makes it possible to start and stop the power from the house, by simply pulling a wire which operates a valve in a small water pipe, from which water under pressure is let into a hydraulic cylinder. This causes the piston of the cylinder to rise and the piston being directly connected to a gate in the water pipe inlet, allows the water to flow into the water wheel. When it is desired to stop the plant, a pull on the companion wire causes the reverse operation to take place and the power is shut off.

Near the village of Berlin, in eastern Rensselaer county, N. Y., there is a small power development owned by Mr. Arthur Cowee. His source of power is a small trout brook which flows through the farm. Mr. Cowee is a producer of fancy gladiolus bulbs, on a large scale. His principal power development consisting of a 36inch impulse water wheel under a pressure due to a fall of about 210 feet, is used mostly for the purpose of operating a circular saw and other machinery connected with a saw mill. The water is diverted from the natural channel of the brook at a considerable distance from the place where the water wheel is installed and is carried in an artificial channel about four feet wide and three feet deep around the side of the hill, where it runs into a hollow basin which has been excavated by Mr. Cowee at a suitable location. By means of this basin or artificial pond, practically all of the flow of the brook may be stored during the night and used to operate the water wheel during the day. In this manner the full power value of the brook is realized. There is a ten-inch cast iron pipe line about 1,680 feet long, which runs from the pond down the side of the hill to the water wheel. This pipe line was placed underground from three to four feet in order to avoid freezing in the winter. Mr. Cowee estimates that the development, including the diverting dam and canal, pond, pipe line, water wheel, circular saw and accessories cost him a total of about \$7,000. He states that he can saw about 4,000 feet of lumber in a day with this power.

In addition to this development, Mr. Cowee also has a small impulse water wheel in his bulb house. This wheel is operated by water furnished from the system of the local water company. It is directly connected to a small electric generator which furnishes electricity sufficient for 157 sixteen-candle-power carbon filament lamps which are installed throughout the bulb house. The generator does not produce enough electric current to run all of these lights at the same time, but it will operate as many as forty-five or fifty lights at one time, which is all that is necessary to meet the requirements.

Mr. D. F. Paine, of Wadhams, Essex county, N. Y., has a dam at the outlet of Lincoln Pond. The water surface when the pond is full is about twelve feet above the normal and spreads over an extensive tract of low marshy land. The pond thus formed is about three miles long and from one-quarter to three-quarters of a mile wide. The water is conducted from the dam to the penstock, a distance of about a mile and a half, securing a fall of 320 feet. At this point Mr. Paine has constructed a power house where he generates electricity which he transmits to Mineville for use in the mines. This power is transmitted a distance of about eight miles.

At Chazy, N. Y., near the western shore of Lake Champlain and at a point about fifteen miles north of the city of Plattsburg, there is located a modern stock and dairy farm which, in its operation, exemplifies the manifold advantages to be derived from the use of hydro-electric power for electric lighting and for the various power requirements of the farm. This farm, which is owned by Mr. W. H. Miner, and is called "Heart's Delight," covers an area of 5,160 acres. About 1,200 acres are cultivated, 1,200 acres are in pasture and the remainder is woodland. The output ccasists of live stock and dairy products, all crops grown on the farm being fed to the stock and only finished products being shipped out. The live stock includes registered Percheron and Belgian horses, pure bred short-horn Durham and Guernsey cattle, Dorset sheep and high-grade hogs for the production of sausage, hams and bacon. There are also poultry and squabs and a fish hatchery for the propagation of trout. The entire output goes directly to high-grade hotels in New York, Washington and Chicago.

Two streams pass through the southern portion of the farm, the smaller one being known as Tracy brook and the larger one as Chazy river. It was decided to provide the farm with electricity for light and power. Enough water power was found in these streams to furnish a cheap and reliable source of energy. Accordingly a hydro-electric plant was installed several years ago, which has given such satisfaction that the equipment has been increased from time to time, and some novel applications have resulted. Three small concrete dams were built across Tracy brook to form storage reservoirs. A concrete penstock, or pipe, forty-four inches in diameter and 670 feet long carries the water from the downstream reservoir to a concrete power house where a fall of nineteen feet is secured.

The power-house equipment consists of two water turbines automatically governed and directly connected respectively to one thirty kilowatt and one twelve and one-half kilowatt, 220 volt, direct-current generators. The current is transmitted over a pole line a mile and a quarter long to a central station in the main group of farm buildings.

Another dam was built across the Chazy river. This is of concrete and after passing through screens at the intake gate house, built into the dam, the water flows through a concrete penstock forty-eight inches wide by sixty inches high and 630 feet long, to the power house where a fall of thirty feet is obtained. There are two turbines here, belt connected to generators and the current is transmitted over a pole line nearly three miles long to the central station.

An auxiliary to the water power development consists of two hydraulic rams pumping water from one of the Tracy Brook reservoirs to a 60,000-gallon tank, 100 feet above the ground, for fire protection for the buildings.

There are in all about twenty-five motors installed in the various buildings. The electric current actuates these motors, which are used to drive or operate numerous machines and labor-saving devices.

An entire load of hay is lifted from the wagon and stored in the mow by a ten horse power motor. Λ root-cutting machine is operated by a two horse power motor mounted on the ceiling above



CASCADE ON INDIAN CREEK, WARREN CO., N. Y. Typical example of undeveloped water power.





it. A one and one-half horse power motor drives a vacuum pump which operates the milking machines. Five machines are used, each of which will milk two cows simultaneously. A one and one-half horse power motor runs the cream separator, and a three horse power motor drives the big churn, and motors are used for driving the water pumps as well as the brine circulation pumps in the ice-making plant. A grist mill driven by electric motor is part of the farm equipment, and the sausage-chopping and mixing machines are driven by a four horse power motor. Roots for the sheep are cut by a machine driven by motors of one and a half and two horse power, and food for the fish is prepared by a grinding machine driven by a two horse power motor. Woodworking machines and machine tools are driven by motors in the carpenter and machine shops.

In addition to the uses already mentioned, the electric power is also used to pump water, shear the sheep, clip the horses, wash, dry and iron the clothes, heat the house, cook the food, freeze the ice cream, cool the house in the summer, curl the ladies' hair and play the piano.

DEVELOPING A SMALL WATER POWER.

The prime requisite to the creation of a water power is the existence of falling or flowing water. The amount of power which may be available varies first, with the amount of water flowing, and second, with the amount of fall. It requires about one cubic foot of water per second, falling through a height of ten feet to make available one theoretical horsepower. The fall may be either naturally concentrated at one point in a cascade or it may be artificially concentrated, for the purpose of development, by combining the fall of several cascades or a series of rapids. This may be accomplished by either of two methods; first, by building a dam at the downstream end of the rapids to impound the water so that the entire fall is concentrated at the dam, or second, by building a dam at the upstream end of the rapids and conducting the water through a closed pipe to the lower end of the rapids where the resulting water pressure will be exactly the same as in the first instance. A variation of the latter method consists of diverting the water from the natural

channel at the head of the rapids and carrying it in a canal, on a slight down grade, along the side of a hill to a suitable point at which the water is turned into penstocks, which run directly down the slope to the stream, where the power development may be made. The latter method, involving the construction of a canal, is open to the objection that considerable trouble is usually experienced from the accumulation of ice in the winter time. The first two methods described are the most common.

The amount of water which flows in a stream in New York State, whether large or small, is subject to remarkable variation. Only one who has observed very carefully and continuously by actual measurement the extremes of fluctuation to which a flowing stream is subject, is in a position fully to appreciate this. Some of the larger rivers of New York State are subject to such fluctuations of flow that the amount of water discharged during flood periods is several hundred times as much as the amount that flows in the extreme dry period. Also, in many instances from one-half · to three-fourths of the total runoff of the stream during the year occurs during a period of a few weeks in the spring months when the accumulated snow and ice is melted and runs off in conjunction with the warm spring rains. Unfortunately, reliable data relating to the fluctuations of small streams in this State are very meager. It is, however, a matter of record that the smaller streams for which records are available, are subject to greater fluctuations per unit of tributary watershed area than are the larger streams. It seems logical, therefore, to assume that the very small creeks and brooks are subject to fluctuations relatively greater than those recorded for streams of only relatively This fact must be borne in mind by any one who proposes to develop the power on a stream, for if it is overlooked the project is not so assured of success. For most purposes power is required in about the same amount for all seasons of the year, while, as previously stated, the streams run off most of their waters in the spring. Therefore, in developing the power of any particular stream, if the power is required to be fairly constant at all seasons of the year, as is usually the case, there are two considerations which must not be overlooked:

First: Will the minimum flow of the stream — that is, the flow which occurs in the driest season of a dry year — be sufficient to furnish the amount of power required?

Second: If the minimum flow is not sufficient, what means are available for storing the surplus water from the wet season until the dry season?

The subject of equalizing stream flow throughout the year by means of storage reservoirs has been so thoroughly discussed in the reports of the Commission that further discussion in this connection does not seem warranted.

Taking a general average throughout the State of New York, large streams may be depended upon to produce from one-twentieth to one-quarter cubic foot of water per second per square mile of tributary drainage area, during the driest period. Streams having only one or two square miles of drainage frequently dry up entirely in the dry seasons. If a power development is proposed of such a character that some considerable sacrifice of power might be made in the dry seasons with no serious loss, most small streams may be developed to provide for as much as one-quarter to one-half of a cubic foot per second per square mile. On the other hand, it is often found practicable to provide a small auxiliary power plant, such as gasoline or kerosene, to fall back upon in dry weather or to supply extra power occasionally, in which case the water power development need not be limited to the minimum flow of the stream.

The power of falling water may be applied to practical purposes in several ways. One of the simplest ways, should it be desired to use the power of the stream to pump water, is by means of what is known as a hydraulic ram. This is a device which operates on the principle of the impact due to the sudden stoppage of flow of a column of water. By means of this device, or engine, water falling through a very small height may be used to raise a portion of the same or a comparatively small amount of other water to an elevation considerably higher than the supply. The mechanical efficiency of the hydraulic ram is comparatively high under certain conditions, but generally is very low, useful work which manufacturers claim may be realized varying from 38 per cent to 80 per cent. The minimum fall under which a ram will effectively elevate

water is about two feet. This fall will elevate about one-thirteenth of the supply to a height of twenty feet. Under the most favorable conditions and a fair amount of fall, a ram may elevate water as high as 120 feet. The proportion of water which may be elevated varies from one-twentieth to two-sevenths of the total supplied and accordingly the proportion of water which must be wasted at the impetus valve of the ram varies from five-sevenths to nineteentwentieths. These proportions both depend upon the ratio of the amount of supply to the amount to be elevated, that is, a small proportion may be elevated to a considerable height and vice versa. In cases where a small brook of suitable quality is available for domestic water suppy, it is often entirely practicable to install a hydraulic ram which will pump a sufficient proportion of the amount of supply to furnish a household with all the water necessary for ordinary domestic purposes, in spite of the fact that the brook may be on a lower level than the house. Owing to the fact that a hydraulic ram may be applied only to the purposes of elevating water, it is not generally considered as a means of developing water power, although in the broadest sense it does consist of such a development.

On the other hand, the purposes for which power is usually required are not only for the elevation of water for a water supply, but for many other and varied requirements. In such cases the power must be developed in such manner that it may be utilized to operate machinery near the site of the development, or transmitted for some distance, and there used to operate machinery or for lighting purposes. To develop water power in this manner requires some kind of a water wheel.

There are several types of water wheels, the principal ones being known as "undershot," "overshot," "breastwheel," "turbine" and "impulse." The overshot wheel is a type familiar to most readers, being usually of home manufacture. It consists usually of a wooden wheel with water compartments arranged at regular intervals around the periphery. The water is fed into the wheel at the top, just off the center. It flows into the compartment at the top and the weight being exerted on one side of the supporting axle causes the wheel to revolve, the water spilling out when the compartment or water pocket reaches the bottom. This type of wheel

depends entirely for its power upon the weight of the water which causes the wheel to revolve.

The undershot wheel is very similar in construction to the overshot type but depends more for its power on the velocity of the flowing water which strikes the blades or buckets on the under side of the wheel.

The breastwheel is also similar in construction but is in reality an improvement upon the overshot and undershot types. It depends for its power on a combination of the action of gravity and the impulse of the water striking the blades or buckets. The water is fed into the wheel a little below the height of the axle and usually enters with considerable velocity, a part of which is transformed into useful work by the wheel.

The turbine is a type of wheel which is very extensively used. It is usually constructed of metal and consists primarily of a series of curved vanes or runners whose arrangement is similar to a screw. The action of the water flowing through these curved vanes causes the vanes and shaft to revolve, the vanes being solidly connected to the shaft, which may be either horizontal or vertical.

The fundamental working principle of an impulse water wheel is the turning into useful work of the impulse due to the velocity of a jet of water issuing from a contracted orifice. This is accomplished usually by conveying the water from the dam or other source of supply to the water wheel in a pipe of comparatively large size and then gradually reducing the size of the pipe immediately in front of the wheel to a comparatively small size by means of a reducer section, which is fitted with a nozzle the opening of which may or may not be regulated in size. contraction of the stream of flowing water causes a spouting of the water under pressure and the water issues in a jet with very high velocity. The jet thus issuing from the nozzle strikes the cups of the impulse wheel which are arranged at regular intervals around the circumference of a metallic disc which is centered on an axle. The cups transfer the velocity of the jet to the wheel, and the water drops from them with very little velocity left in it.

In general the turbine type of wheel is best adapted to low heads or falls and the use of comparatively large volumes of water, and the impulse wheel is best adapted to the use of a comparatively high head or fall, and a comparatively small amount of water. There are certain intermediate conditions for which the manufacturers of each type claim their wheel is best suited and in such instances a study of local conditions is always necessary to determine which type of wheel is best adapted.

The development of a water power by means of any kind of a water wheel results in the conversion of the energy of the falling water into mechanical power which is exerted in a more or less rapidly revolving shaft. In order to apply this power of the revolving shaft to some useful purpose, there are several methods which may be used. The shaft may be directly connected to the shaft of an electric generator or dynamo to generate electric current, or it may be directly connected to a machine which it is desired to operate, provided the machine or dynamo is required to operate at the same speed as that of the wheel shaft. This is frequently not the case, so that under ordinary conditions the shaft of the wheel is fitted with a pulley, which in turn is connected by belt to another pulley on the machine which is to be driven.

By using pulleys of different diameters on the shaft of the water wheel and the shaft of the machinery to be driven, the speed of the machine may be several times more or less than the speed of the water wheel. For instance, if the water wheel revolves 200 revolutions per minute and it is desired to operate a machine, connected by belt, at a speed of 1,000 revolutions per minute, a pulley of comparatively small size, say four inches in diameter, is placed on the shaft to be driven, and a pulley of five times the diameter, or twenty inches, is placed on the shaft of the water wheel. This causes the shaft of the machine to revolve at a speed five times as great as the water wheel. If the speed of the water wheel is greater than that required for the machinery to be operated, then the reverse operation is followed out, placing a small pulley on the shaft of the water wheel and a larger one on the shaft of the machinery to be driven. If the speed of the water wheel is to be magnified more than about six times, it usually requires the installation of a countershaft and another series of pulleys in order to avoid the use of very large and very

small pulleys. A pulley which has a very small diameter does not operate satisfactorily without considerable loss of power and a very large pulley is objectionable on account of the space which it requires.

When the water power is once developed it may be applied to practical use either near the place of development or at a considerable distance. If it is to be used for power only, and not for lighting, and can be used where it is developed, there is no need of converting it into electricity. But if it is to be used for lighting. or for power to be applied at a considerable distance from the water power site, then it becomes necessary to convert the power into electricity, in which form it may be most conveniently transmitted from one place to another. This requires an electric generator or dynamo, to be driven by the water wheel, and a transmission line, preferably of copper wire, to carry the current where it is to be used. In order to reconvert the current into power at the end of the transmission line, where the power is to be used, it is necessary to run the current into an electric motor, the shaft of which is made to revolve by the action of the electric current. This motor may then be connected directly or by belt, gears or chain drive, to the machine to be driven.

It should be borne in mind that in each of these steps of changing from water power to electric current, in transmitting the current over the wires, in reconverting it into power, and in transferring this power from a motor to a power operated machine, there is a mechanical loss of energy. These losses vary considerably in different instances. Assuming for illustration, that a water power, whose theoretical power is 10 horse power, is required to drive a power machine at a distance, the efficiencies and losses will be somewhat as follows:

Water wheel, efficiency 80%, Loss 20%, generates 8.0 horsepower. Connections, efficiency 95%, Loss 5%, transfers 7.6 horsepower. Transmission, efficiency 90%, Loss 10%, generates 6.8 horsepower. Motor, efficiency 90%, Loss 10%, transmits 6.2 horsepower. Connections, efficiency 90%, Loss 10%, develops 5.5 horsepower. efficiency 95%, Loss 5%, delivers 5.0 horsepower.

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Therefore, only five horsepower would be actually delivered to the machine to be driven. This amounts to only half of the theoretical power of the falling water, which is actually realized in useful work of the machine being driven. If the power from the water wheel is to be applied directly without generating electricity a much higher efficiency will be realized.

APPENDICES.

- A. DECISIONS OF THE COMMISSION ON WATER SUPPLY APPLICATIONS.
- B. LAWS RELATING TO THE COMMISSION.
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	APPENDI	X A.
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APPENDIX A.

DECISIONS OF THE COMMISSION ON WATER SUPPLY APPLICATIONS

The following table contains a list of the applications filed with this Commission since its creation, together with the disposition made of each case:

No.	Applicant.	Date	of Filing.	Disposition	n.
1.	City of New York	Nov.	3, 1905.	Approved May	14, 1906.
	City of Kingston		8, 1905.	Discontinued.	
3.	City of Oneida	Dec.	2, 1905.	Approved Mar.	16, 1906.
4.	Village of Lyons Falls	Dec.	26, 1905.	Approved Mar.	28, 1906.
5.	Village of Constableville	Dec.	30, 1905.	Approved Apr.	19, 1906.
6.	City of Watervliet	Jan.	25, 1906.	Dismissed Sep.	25, 1906.
7.	Village of Millbrook	Feb.	21, 1906.	Withdrawn Mar	. 5, 1906.
8.	Village of White Plains	Apr.	20, 1906.	Approved June	15, 1906.
9.	City of Lockport	May	24, 1906.	Approved July	13, 1906.
10.	Village of Malone	June	28, 1906.	Approved Jan.	18, 1907
11.	Village of Holland Patent	Aug.		Approved Sep.	25, 1906.
12.	Village of Brewster	Oct.	12, 1906.	Approved Feb.	21, 1907.
13.	Village of Bergen	Oct.	18, 1906.	Approved Nov.	8, 1906.
	City of Gloversville		27, 1906.	Approved Jan.	18, 1907.
-15.	Village of Carthage	Dec.	13, 1906.	Approved Mar.	14, 1907.
16.	Hannacroix Water Co	Dec.	22, 1906.	Approved Oct.	17, 1907.
	City of Plattsburg		19, 1907.	Approved Feb.	27, 1907.
18.	Village of Pleasantville	Feb.	9, 1907.	Approved Aug.	6, 1907.
19.	Village of Seneca Falls	Feb.	21, 1907.	Approved Oct.	16, 1907.
	Village of Waterville				9, 1907.
21.	Village of Old Forge	Mar.	13, 1907.	Approved May	9, 1907.
	Village of Ossining				26, 1907.
	Village of Peekskill				
	Urban Water Supply Co				16, 1907.
	Village of East Aurora				18, 1907.
26 .	Martinsburg Water District	July	2, 1907.	Approved July	15, 1907.
27.	City of New York - Modification				
	of Catskill Aqueduct line	July	12, 1907.	Approved Oct.	15, 1907.
28.	City of New York - Schoharie				
	watershed	July	12, 1907.	Discontinued.	
29.	City of Rome	July	20, 1907.	Approved Aug.	15, 1907.
3 0.	Tannersville Water Co	Aug.	23, 1907.	Approved Dec.	21, 1907.
31.	Great South Bay Water Co	Dec.	14, 1907.	Approved Jan.	21, 1908.

No.		Date	of Filing.	Dispositio	n.
3 2.	City of Gloversville (second appli-				
	cation)			Approved Feb.	
	Village of McGrawville			Approved Mar.	11, 1908.
	Village of Malone		•	Discontinued.	
	Village of Bainbridge			Discontinued.	
	Staatsburg Water Co			Approved Apr.	10, 1908.
	Village of Briarcliff Manor	-	•	Discontinued.	
38.	Palenville Water District	Apr.	•	Petition not co	-
39 .	Harmon Water Co	July	16, 1908.	Withdrawn Sep.	16, 1908.
4 0.	City of New York - Suffolk				
	county sources	Jul y	29, 1908.	Pending.	
	Village of East Syracuse			Approved Aug.	14, 1908.
4 2.	Edmeston Water Co	Aug.	14, 1908.	Approved Sep.	16, 1908.
43.	Village of Marcellus	Aug.	24, 1908.	Approved Sep.	30, 1908.
44.	Village of Shortsville	Oct.	5, 1908.	Approved Feb.	6, 1909.
4 5.	Village of Clifton Springs	Oct.	5, 1908.	Approved Oct.	14, 1908.
46.	Village of Webster	Nov.	23, 1908.	Approved Dec.	12, 1908.
	Syracuse Suburban Water Co	Dec.	1, 1908.	Approved Apr.	9, 1909.
48.	Village of White Plains (second				
	application)				
49 .	City of Glens Falls	Mar.	6, 1 0 09.	Approved Apr.	21, 1909.
5 0.	City of New York - Nassau				
	county sources	Mar.	12, 1909.	Approved May	15, 1909.
51.	Village of Bainbridge (second ap-				
	plication)				
	Fultonville Water Co				
	Village of West Carthage				
54.	Rensselaer Water Co	Apr.	12, 1909.	Approved Apr.	21, 1909.
5 5.	City of Niagara Falls	Apr.	20, 1909.	Approved July	14, 1909.
56.	Village of Webster (amended ap-				
	plication)				
	Village of Canajoharie				
58.	Village of Croghan	June	17, 1909.	Approved Sep.	22, 1909.
	Village of Mechanicville				
6 0.	Central Bridge Water Co	July	2, 1909.	Approved July	29, 1909.
61.	Whitney's Point Water Co	July	8, 1909.	Approved July	30, 1909 .
62.	Water District of Town of Peters-				
	burg				14, 1909.
63.	Village of Livonia	July	16, 1909.	Approved Oct.	21, 1909.
64.	Village of Mt. Morris	Aug.	2, 1909.	Discontinued.	
65.	Village of Painted Post	Aug.	18, 1909.	Approved Sep.	3, 1909.
66.	Village of Farmingdale	Sept	22, 1909.	Discontinued.	
67.	City of New York - Modification	_			
	of Catskill Aqueduct	Dec.	16, 1909.	Approved Oct.	7, 1910.
68.	Village of Barker	Jan.	11, 1910.	Discontinued.	
69.	Jamaica Water Supply Co	Jan.		Approved Feb.	15, 1910.
	Village of Pike			Approved Mar.	10, 1910.
71.	Village of Keeseville	Mar.		Approved May	25, 1910.

No. Applicant.	Date	of Filing.	Disposition	n.
72. Otisville Water District		4, 1910.	Approved Nov.	30, 1910.
73. Village of Spencerport	Mar.	23, 1910.	Approved May	10, 1910.
74. City of Plattsburg	Mar.	24, 1910.	Denied May	20, 1910.
75. Village of Croton-on-Hudson	Apr.	6, 1910.	Approved Aug.	24, 1910.
76. Harrison Water District No. 1	Apr.	18, 1910.	Approved May	20, 1910.
77. Greenwich Union Water Works Co.	Apr.	29, 1910.	Approved May	11, 1910.
78. Village of Black River	May	3, 1910.	Approved May	20, 1910.
79. Belfast Water District	May	26, 1910.	Approved July	7, 1910.
80. Village of Moravia	July	6, 1910.	Approved Aug.	24, 1910.
81. Village of Canajoharie	July	13, 1910.	Approved Aug.	10, 1910.
82. Village of Youngstown	July	20, 1910.	Approved Aug.	24, 1910.
83. City of Hornell				
84. Village of Silver Springs	Aug.	12, 1910.	Approved Nov.	3, 1910.
85. City of Ithaca				7, 1910.
86. Roslyn Water District				25, 1910.
87. Village of Cherry Creek	Sept.	6, 1910.	Approved Oct.	7, 1910.
88. Andes Water Co	Sept.	12, 1910.	Approved Oct.	7, 1910.
89. Village of Oriskany Falls	Oct.	11, 1910.	Approved Nov.	3, 1910.
90. Summerville Water District	Oct.	20, 1910.	Withdrawn Oct	.28, 1910.
91. John A. Drew	Oct.	28, 1910.	Approved Dec.	29, 1910.
92. Village of Angola	Dec.	7, 1910.	Approved Dec.	29, 1910.

APPLICATION NO. 67.

NEW YORK CITY. Modification of Catskill aqueduct.

Petition filed December 16, 1909.

Hearings held January 12, February 10, February 28, March 23, April 28, May 24, June 29 and July 13 and 14, 1910.

The petition asked for approval of plan-to change the manner of delivering the water from the Catskill mountain sources to the several boroughs of the city. The plan provides for the distribution of the entire supply of water by means of a deep pressure tunnel from Hillview reservoir through the boroughs of the Bronx and Manhattan and extending to Brooklyn, supplemented by pipe lines to the boroughs of Queens and Richmond. It is proposed to construct a reservoir of four or five hundred million gallons capacity for local distribution in Richmond.

The Commission approved the application October 26, 1910.

Decision filed October 26, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter of the Application of

THE CITY OF NEW YORK to the STATE WATER SUPPLY COMMISSION for the approval of the report of the Board of Water Supply of the city of New York to the Board of Estimate and Apportionment of the city of New York, dated November 15, 1909, recommending modification of the map, plan and profile, dated October 9, 1905, approved by said Commission May 14, 1906, which modification is dated November 15, 1909, and is entitled "Board of Water Supply of the City of New York. Map and profile showing manner of delivering the water to the several Boroughs."

Decision.

On December 16, 1909, the petition in the aforesaid matter was duly filed with this Commission. The Commission caused public notice to be given as provided by law that on the 12th day of January, 1910, the Commission would conduct a public hearing thereon at the office of the Board of Water Supply of the city of New York. Pursuant to such notice duly given, the Commission met at the office of the Board of Water Supply, 299 Broadway, New York city, for the purpose of such a hearing, noted the appearances, and received in evidence such documentary evidence as the applicant offered.

The Board of Estimate and Apportionment of the city of New York, by its resolution bearing date January 7, 1910, requested this Commission "to defer final action on any projected extensions or modifications of New York's water supply system." In compliance with this request and upon motion of the corporation counsel for the petitioner, the proceedings were adjourned from time to time and until July 13, 1910, prior to which last named date, and on July 1, 1910, the said Board of Estimate and Apportionment of the city of New York rescinded its resolution of January 7, 1910, aforesaid. Said Board did by resolution of the same date approve and adopt the report, map, plan and profile of the Board of Water Supply dated November 15, 1909, and declared the same to be the final map, plan or plans approved and adopted by the Board of Estimate and Apportionment pursuant to the provisions of chapter 724 of the Laws of 1905 as amended.

The petition in substance prays for the approval by this Commission of the plan of the Board of Water Supply of the city of New York, duly submitted to and approved and adopted by the Board of Estimate and Apportionment of the city of New York, for the distribution of the water supply to be secured from the Catskill mountain sources to the various boroughs of the city of New York. The general plan for the additional water supply for New York city, approved by this Commission on the 14th day of May, 1906, provided for the construction of storage reservoirs in the Catakill mountains and an aqueduct running from such reservoirs to New York city. It was brought out at that time that the plans for distribution of the water to the various boroughs were only tentative and that the same would be covered by a subsequent application to this Commission. The present petition, therefore, relates only to an extension or modification of the original plan for distributing water to various boroughs of New York city. The proposed plan specifically contemplates the distribution by means of a deep pressure tunnel from Hillview reservoir through the boroughs of the Bronx and Manhattan and extending to Brooklyn, supplemented by pipe lines to the boroughs of Queens and Richmond, of the entire supply of water that may be obtained from the Catskill sources. In the borough of Richmond it is proposed to construct a reservoir of four hundred or five hundred million gallons capacity for local distribution purposes.

The evidence shows that exhaustive studies have been conducted by the engineers for the city to determine the most feasible and suitable method for the distribution of this Catskill mountain supply to the various city boroughs. The reports and data submitted to this Commission by the Board of Water Supply with the petition, together with the evidence given at the hearing, indicate clearly that the plan proposed, namely, the pressure tunnel project, is both feasible and economical. The information at hand and the evidence adduced at the hearings also clearly indicate that the proposed plan is thoroughly adequate to meet all reasonable needs of the city for a considerable period of time and will result in the least possible inconvenience to the public and do the least damage to property during its construction.

It is also shown that the increased pressure which will be available from the proposed tunnel in some of the districts to be served will result in a great saving to the city by obviating the necessity of pumping large amounts of water, which, under any plan contemplating comparatively small pipes, would have to be pumped in order to afford sufficient pressure for satisfactory domestic service and fire protection.

The Commission has made a careful study of the project proposed, and of the evidence submitted by the petitioner, and is of the opinion that the proposed plans are both wise and economical.

It is evident that some proper method for the distribution of the proposed Catskill mountain water supply to the various boroughs of New York city is absolutely essential to the successful completion and operation of that proposed system, and it having been clearly shown that the proposed plan is both feasible and economical, this Commission, therefore, finds:

That the plans of the petitioner are justified by public necessity.

The present petition does not contemplate any action on the part of the city of New York that will affect in any manner whatever any other municipality or civil division of the State or the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

The plan of the city to pay for any and all damages that may result from the execution of said plans and the acquiring of any lands that may be necessary therefor is to purchase the lands and with the money allowed it by the Board of Estimate and Apportionment to pay for such lands and for any and all damages, whether direct or indirect, that will result therefrom.

The Commission, therefore, finds and determines:

First: That the plans of the petitioner are justified by public necessity.

Second: That the plans of the petitioner are just and equitable to other municipalities and civil divisions of the State affected thereby, and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

Third: That the plans of the petitioner make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which may result from the execution of the plans of the petitioner or the acquisition of the lands therefor.

The State Water Supply Commission does, therefore, grant the petition and approve the application and plans of the petitioner.

In WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the

[I. S.] same with all maps, plans, surveys and other documents and papers relating thereto filed in its office in the City of Albany this 20th day of October, 1910.

HENRY H. PERSONS.

President.

JOHN A. SLEICHER, MILO M. ACKER, CHARLES DAVIS, ROBERT H. FULLER, Commissioners.

APPLICATION NO. 68.

BARKER (Incorporated Village), Town of Somerset, Niagara County. Petition filed January 11, 1910.

Hearing held February 4, 1910.

Present source of supply, driven or dug wells. No public system. For fire protection there is one hand fire engine.

The petition asked for approval of plan to take water from Lake Ontario, a filtration gallery, 50 by 25 feet to be built on shore of lake and connected with a pump well. Plans provide for a triplex pump driven by a gasolene engine stationed near pumpwell and the water pumped to a standpipe within village limits, dimensions of which would be 14 feet in diameter by 90 feet high, with a capacity of 104,000 gallons. The distributing system consists of four, six, eight and ten-inch cast iron pipe and thirty double nozzle fire hydrants, 400 feet apart.

Estimated cost of proposed project, \$24,000.

At a vote of the taxpayers held June 16th, the proposition to install the system was defeated and the application was withdrawn.

APPLICATION NO. 69.

JAMAICA WATER SUPPLY COMPANY (domestic corporation), Queensborough, Queens county.

Petition filed January 13, 1910.

Hearing held February 2, 1910.

The company is engaged in supplying water to Jamaica and also Richmond Hill, Hollis, Springfield, Jamaica South, Dunton, Morris Park, Floral Park and New Hyde Park (latter two in towns of Hempstead and North Hempstead).

Source of supply is from driven wells pumped from two stations each with a capacity of five million gallons per twenty-four hours to standpipes and from there through supply pipes to the towns and villages. The district is a rapidly growing one and the supply has proved insufficient for both fire and domestic purposes.

The petition asked for approval of plan to drive thirty-six wells at Elmont, town of Hempstead on land owned by the company, covering about 15.32 acres.

Analyses showed the water to be of good quality and suitable for all domestic purposes including drinking.

The Commission approved the application February 15, 1910.

Decision filed February 15, 1910.

BEFORE THE STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the JAMAICA WATER SUPPLY COMPANY.

Decision.

Application filed January 12, 1910.

Hearing at Jamaica, N. Y., February 2, 1910.

Decision February 15, 1910.

The Jamaica Water Supply Company is a domestic corporation organized under the laws of the State of New York, having its principal office at Jamaica, county of Queens, State of New York. It is engaged in furnishing water, by pumping, for domestic use and fire protection in Jamaica, which is now part of the greater city of New York, and to Richmond Hill, Hollis, Springfield, Jamaica South, Dunton, Morris Park, Floral Park and New Hyde Park (which latter two are located in the towns of Hempstead and North Hempstead). The evidence shows that this is a rapidly growing district. The Jamaica Water Supply Company at present has two pumping stations with a capacity of about five million gallons each per twenty-four hours. The evidence also shows that this supply has proved insufficient both for domestic purposes and fire protection in the locality served, various complaints having been made to the company by its patrons. The company pro-

poses to acquire about 15.32 acres of land situated on the Hempstead and Jamaica Turnpike road about 3,600 feet east of the New York city line. The company has an option on this property and has sunk a test well to the depth of ninety feet which shows an ample supply of pure and wholesome water. It is financially responsible and able to pay any damages that may be awarded. The plans submitted indicate that the company purposes to sink about thirty-six wells on this property which will produce between four and five million gallons per day. This quantity is believed to be sufficient to meet the increasing demands made upon the company. It is proposed to connect this new supply by conduit to their present system. The analysis of the water shows it is of good quality and suitable for all domestic purposes, including drinking. No one appeared in opposition at the hearing and it is evident no other municipality or civil division of the State will be affected by the proposed plans of the applicant.

The State Water Supply Commission therefore determines:

First. That the plans proposed by the Jamaica Water Supply Company are justified by public necessity.

Second. That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

Third. That the said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the maps of the lands to be acquired by the Jamaica Water Supply Company for a new or additional source of water supply and the plans or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of said lands and the execution of said plans.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the [L. S.] same with all plans, maps, surveys and other papers relating thereto filed in its office in the city of Albany, this 15th day of February, 1910.

HENRY H. PERSONS,

President.

JOHN A. SLEICHER, MILO M. ACKER, CHARLES DAVIS,

Commissioners.

APPLICATION NO. 70.

PIKE. (Incorporated village.) Town of Pike, Wyoming county. Petition filed February 3, 1910.

Hearing held February 25, 1910.

Village has no public system and takes water from private wells.

Petition asked for approval of plan to take water from Lyon and Miller springs, gauging about 58,100 gallons daily, to serve a population of 450. Reservoir situated 100 feet below Lyon spring, with a capacity of 168,000 gallons.

Analyses showed a very moderate amount of organic matter, and bacteria of the B. Coli type were not present.

Total estimated cost of the proposed project, \$20,500.

The Commission approved the application March 10, 1910.

Decision filed March 11, 1910.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter

of

Decision.

The Application of the VILLAGE OF PIKE for a new and additional source of water supply.

Present: Henry H. Persons, President; Charles Davis and Milo M. Acker, Commissioners.

OPINION.

The village of Pike, by its president and its board of trustees, on the 3d day of February, 1910, filed with this Commission a verified application asking for the approval of its maps and plans for a new source of water supply. The application was accompanied by maps, plans and a report of Frederick K. Wing, a civil engineer, showing the plans proposed and the estimated cost of the installation of such a municipal water plant.

The matter came on for hearing on the 25th day of February, 1910, pursuant to a notice duly given as provided by law and the rules of the Commission.

The village was represented by Mr. H. E. Harding, its counsel, and by Thomas Culver, its president, and Edward Goepp, one of its trustees.

No objectors appeared on the day of the hearing except Mr. S. J. Russell, who had previously filed objections, and Mr. D. A. Green, who had asked, by letter dated February 15, 1910, the Commission to consider a petition of taxpayers protesting against the granting of the application. No such petition, however, was filed.

The village of Pike has a population of 450 people and an assessed valuation of \$150,975; a bonded indebtedness of only \$250 and no public water supply whatever.

The water for domestic purposes is now derived from wells owned by individuals and located on private property as is common in all villages before the installation of public supplies. It has no adequate fire protection. It has, however, a hand fire engine and takes water for fire protection from a creek running through one side of the village. Whenever a fire occurs at a point 400 feet or more distant from the creek, there is no fire protection at all. Only about one-third of the village is protected by the hand fire engine and its equipment.

The village has voted, as provided by the village laws, for the raising of \$15,000 to install a municipal water plant. This village is situate in the valley of the Wiscoy creek. It proposes to go to the west about 672 feet at an elevation of 126 feet above the village and utilize a spring known locally as Lyon spring. The plan presented is to completely protect this spring from all possible contamination and then construct a reservoir about 100 feet below the spring with a capacity of 168,000 gallons, which will of itself furnish 175 gallons per minute for each of four streams for four hours in case that amount of water is needed for fire protection. The spring and this reservoir will furnish ample water for domestic purposes of the village for the present and is so situated that it can be re-enforced by piping the waters from another spring known locally as the Miller spring situate about 2,000 feet nearly northwest of Lyon spring and at an elevation of 15 feet above it, if the future demands of the village of Pike should require it.

The plans of the village propose to run its pipes so as to furnish water for domestic purposes to practically all of the houses in the village and to establish fire hydrants so as to afford ample fire protection to the entire village. By utilizing the Lyon spring in the manner proposed, the plant can be installed within the limits of the money voted by the village for the purpose.

The water of the spring has been analyzed and although the analysis shows slight contamination, such contamination is evidently caused by surface water which ran into the spring at the time the sample for analysis was taken. By protecting the spring as proposed in the plan, it is feasible to shut out all possible contamination from surface water, dust, or otherwise.

The village of Pike is situate about six miles distant from any other incorporated village. The village proposes to purchase the land upon which Lyon spring is situate and any other lands necessary for the installation of its proposed municipal plant if it can agree with the owners of the property to be taken upon its value and if an agreement cannot be had, then to obtain such property by condemnation proceedings and in either event, to pay for the property out of the money voted by the village for the installation of this water system.

The village also agrees in its application that it will stipulate in case a claim is made for damages, that the claimant shall not be limited in the reception of evidence to the rules reglating the proof of direct damages. There are no other municipalities or civil divisions of the State that will be affected by the installation of the proposed municipal water system.

It is evident that a municipal water plant owned by this village and which will supply an abundance of pure and wholesome water for domestic purposes and provide ample fire protection to the village would contribute to the comfort of the community, protect its property from destruction by fire and thereby make its property more valuable and the community a more desirable place of residence.

DECISION.

The State Water Supply Commission, therefore, determines:

First: That the plans proposed by the village of Pike are justified by public necessity.

Second: That such plans are just and equitable to other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to the present and future necessities for sources of water supply.

Third: That the plans proposed by the village of Pike make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of such plans.

The State Water Supply Commission does hereby approve the map and plans of the village of Pike for a new and additional source of water supply and the profiles thereof showing sites and areas of the proposed reservoir and other works, the profile of the pipe lines and the flow lines of the water when impounded, plans, surveys and official reports relating to the same and the plan or scheme to determine and provide for the payment of a proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of said lands and the execution of said plans.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION has caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto and the

[r. s.] same, with all plans, maps, surveys and other papers relating thereto filed in its office in the city of Albany, this 10th day of March, 1910.

HENRY H. PERSONS,

President.

MILO M. ACKER,
JOHN A. SLEICHER,
CHARLES DAVIS,
State Water Supply Commission.

APPLICATION NO. 71.

KEESEVILLE. (Incorporated village.) Towns of Ausable and Chesterfield, Counties of Clinton and Essex.

Petition filed March 4, 1910.

Hearing held March 25, 1910.

Village had been taking its supply from Ausable river but water had become polluted.

Petition asked for approval of plan to construct two artesian wells, 475 feet deep, giving a supply of ninety gallons a minute, to serve a population of 2200. The plans also provide for a pumping plant at the wells on the bank of the river, equipped with a water wheel. Also an auxiliary steam plant to be used during dry months. The reservoir which is to be located 300 feet above the pumping station and connected with it through the pipes of the distribution system, will be excavated out of solid granite, lined with concrete and have a capacity of 500,000 gallons.

Analysis showed the water to be of excellent quality.

Total estimated cost of proposed project \$20,000.

The Commission approved the plans of the applicant March 25, 1910.

Decision filed May 4, 1910.

STATE OF NEW YORK -- STATE WATER SUPPLY COMMISSION.

In the Matter

of

Decision.

The Application of the VILLAGE OF KEESEVILLE for approval of its maps, plans and profiles for a new source of water supply.

Application filed: March 4, 1910.

Hearing at Village of Keeseville: March 25, 1910.

Decision: March 25th, 1910.

The village of Keeseville is situate partly in the town of Ausable, Clinton county, and partly in the town of Chesterfield, Essex county, and on the Ausable river, which passes through the village, forming the boundary line of the two counties. The village is one of the municipal corporations of the State. For the past twenty years the number of its inhabitants has not varied to any particular extent from 2200. The present total assessed valuation of all the property, real and personal, in the village is approximately \$600,000, and the only indebtedness is the sum of \$10,000, of which \$6,000 is a balance due for the present water supply, and \$4,000 for street improvements. In or about the year 1883, the village constructed a system of municipal waterworks, comprising a pumping station on the bank of the

river within the village limits, six or seven miles of distributing piping with the customary gates and suitable fire hydrants well located; so far as appears the system has met its intended purpose and is now in good physical condition. The supply of water is taken directly from the river and without either storage or filtration of any kind is pumped directly to the consumers. At the time of the construction of the plant, the river afforded a suitable quality of water for all its purposes. With the growth of population and manufacturing along its course, its water became gradually polluted until at the present time its water is unfit for domestic use, and while the quantity of water is abundant and the fire protection afforded is satisfactory, the use of this water for potable or other domestic purposes has been almost entirely abandoned. The inhabitants now obtain a temporary supply from springs and wells. It is obvious that this condition of the water supply in so large a village as Keeseville should excite the apprehension of its inhabitants as well as that of those charged with the duty of furnishing to its people an abundant and pure supply of water, and in April, 1909, the qualified electors of the village by an affirmative vote of 123 to 65 opposed adopted a proposition to raise the sum of \$20,000 for the purpose of obtaining a supply of pure water. Thereafter the village authorities caused to be made careful investigation of the surrounding country and its possibilities as to sources of water supply and it was found that there were only two natural bodies of water commercially accessible, one Augur lake, and the other Butternut pond. The altitude and intervening topography is such that either or both could be conveyed by a gravity conduit to the elevation of the present pumping station on the bank of the river, from which it would be necessary to pump the water to a standpipe or reservoir of sufficient altitude to furnish adequate fire pressure. There were objections, however, to the use of these waters both from sanitary and economical standpoints, and after mature consideration the municipal authorities determined to obtain the supply from artesian wells located near the bank of the river and within the village limits and upon property now owned by the municipality. One of the wells having an eight-inch bore has already been sunk about 500 feet and affords a flow of 90 gallons per minute. While this is possible with careful and economic use sufficient for the present needs of the village, it was wisely determined to be too little to meet the probable necessities of the village and the construction of another similar well has been commenced.

The Ausable river furnishes for only about eight months in the year sufficient water to furnish power for running the present pumps, and it is proposed to install a steam or gasolene engine to tide over the dry period on the river. In order to provide sufficient quantity of water for the required fire protection and to obtain the full benefit of reduced fire insurance rates, it is proposed to hold in storage under pressure about one-half million gallons. This is to be provided for by a reservoir blasted out of solid granite and lined with concrete to avoid leakage, located on what is locally known as Prospect Hill, about one mile outside of the corporation and at an elevation above the pumping station of about 300 feet and about 200 feet above the average level of the residential section. The reservoir is to be connected with the pumping station through the pipes of the distribution system and an extension of the same, so that it will have the effect of maintaining a constant pressure ample for domestic and fire protection purposes.

The only property the village will be required to purchase is a plot in the town of Chesterfield upon which to construct the reservoir and the necessary right of way for the pipe line to the distributing system.

An analysis of the water has been made from which it appears that the water from the wells is entirely satisfactory and suitable for a domestic supply.

The water being obtained from driven wells and the underground supply being undoubtedly abundant, there will probably be no question raised against the plans on the ground that the taking of the proposed water will affect other municipalities and civil divisions of the State.

No objections to the plans of the applicant were filed with the Commission by any person, municipality or civil divisions of the State.

The State Water Supply Commission having examined the maps and profiles of said application and heard the proofs and arguments submitted in support of the proposed project and due deliberation having been had thereon, determines:

- (1) That the plans proposed by the Board of Water Commissioners of the village of Keeseville for a new or additional source of water supply for the village of Keeseville are justified by public necessity.
- (2) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.
- (3) That said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The said State Water Supply Commission does hereby approve the application of the Board of Water Commissioners of the village of Keeseville as presented.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this decision to be made and signed and hath caused its [L. s.] official seal to be affixed and the same. with all plans, maps, surveys and other papers or records relating thereto, filed in its office in the city of Albany, New York, this 25th day of March, 1910.

HENRY H. PERSONS,

President.

CHARLES DAVIS,
JOHN A. SLEICHER,
Commissioners.

APPLICATION NO. 72.

OTISVILLE. (Water district.) Town of Mount Hope, Orange county. Petition filed April 4, 1910.

Hearings held April 27, May 31, July 6 and August 10, 1910.

Village has no public supply and depends on twenty-two private wells and cisterns.

Petition asked for approval of plan to take water from spring on property of Wheat and Savage with a watershed covering an area of twenty-three acres.

It is to be a gravity system with a reservoir covering 1% acres, a depth of 16½ feet and having a capacity of 6,000,000 gallons. An eight-inch cast iron main will connect distributing system with reservoir. Population 389. Estimated cost, \$20,000.

Analysis showed water to be of good quality and the number of bacteria per C. C. not high for spring water.

The Commission approved the plans of the applicant, November 30, 1910. Decision filed November 30, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter

of

Decision.

The Application of THE OTISVILLE WATER DIS-TRICT for the approval of its maps, plans and profiles for a new water supply.

This is an application by a water district situate at Otisville, in the town of Mount Hope, Orange county, for the approval of its maps, plans and profiles for a water supply for the district and for authority to take and acquire the lands described in the petition for the purpose of its water works system.

The water district embraces practically all of the unincorporated village known as Otisville, which is a station of the main line of the Erie railroad in Orange county. The population of the district is from actual count 389; the assessed value of the real property within the district is \$359,182.99, which amount includes \$280,180 of assessed value of the Erie railroad. Included within the water district are 80 dwellings, 8 general stores with families living over 6 of them, 2 creamery buildings, 3 coal sheds, 1 feed store, 1 railroad station, 1 schoolhouse, 2 barber shops, 2 hotels, 3 churches and 48 other buildings used as barns and sheds, making a total of 151 buildings, of which 10 are brick.

That portion of the district, which is contiguous to the railroad station and to the stores, hotels and churches, is closely built up. At the present time there is no public water supply, nor any fire protection whatever.

The people of the district depend upon some 22 private wells and upon private cisterns for their water supply and have suffered seriously from a shortage of water during the dry months of the year.

A private water company, known as the Mount Hope Water Supply Company, organized to supply this locality with water for fire protection and domestic uses in 1907, purchased a proposed reservoir site some 4,000 feet from the center of the district and a right of way for a pipe line from the reservoir to the village. It also controls a system of springs near the reservoir site from which the supply of water was to be obtained, and it also owns water rights and easements for pipe lines over private property and in the

public highways, with rights of access for purposes of construction and maintenance of pipe lines, but no construction work has yet been done.

The stockholders of this water company are all residents of the Otisville water district, and the company, with the written consent of these stockholders, has made an agreement to convey to the water district all its rights and property for a consideration of one dollar.

The plan of the water district contemplates the construction of an adequate gravity water supply system for the district utilizing the real property and rights of the private water company to be given to the district and to be owned and operated by the water district. The contemplated reservoir has an area of about one and two-thirds acres, an extreme depth of 16½ feet and a storage capacity of 6,000,000 gallons. The watershed above the reservoir has only twenty-three acres, but the supply of water from the springs appear to be more than would naturally flow over a shed of this size. Two of these springs have flowed continuously during the exceptionally dry weather of 1908 and 1909.

The elevation of the water in the reservoir will be about 150 feet above the center of the village and an eight-foot cast iron main will connect the distributing system in the village with the reservoir. The distributing system of cast iron pipes will be accessible to all the buildings and twenty fire hydrants are to be located so as to give fire protection to all the property in the district.

The water from the springs has been analyzed by competent authorities and proves wholesome and free from contamination. There are no buildings or sources of pollution within the watershed from which contamination could come. The water is of a good quality for domestic uses.

No other municipalities or civil divisions of the State are affected by the plans of the applicant, and the plans presented make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of the plans and the acquiring of the lands.

Approval of this application would follow quickly were it not for the objections that have been raised.

After notice had been given of this application, objections were filed by the Eric Railroad Company and several others, residents and owners of property in the district. These objections may be summarized as follows:

- (1) There is no legally erected water district.
- (2) The proposed water supply system for the district cannot be constructed for the sum of \$20,000, the maximum amount stated in the petition to the Town Board, which established the district.
 - (3) The proposed plan will not provide sufficient supply of water.

Upon the hearing, the objectors made offers of testimony which it was claimed would show that the Otisville water district had not been established in conformity to the statute. (§§ 282 to 287, Town Law.)

It appeared, however, from the face of the petition, the map and plan annexed thereto, the filing in the offices of the town and county clerk, the publication of the notice of such filing and of the time and place of meeting of the town board to consider the petition, the determination of the town board thereon and the order establishing the district, and appointing the water commissioners, that all such proceedings were in conformity to the

statute, and we hold that we are bound by the order of the town board, organizing the district, that this Commission has no jurisdiction to make any finding or determination relative thereto, where, upon the face of the proceedings, it appears that the statutory requirements had apparently been observed.

The maximum amount stated in the petition to the town board to be expended in the construction of the proposed system was \$20,000. Upon the hearing there was testimony to show that the estimated cost of the work was at least 50 per cent more than that amount, as well as testimony to show that the work could be constructed for the sum of \$20,000. As the statute relative to water districts (\{\frac{5}{287}}, Town Law) provides that the commissioners of the district shall advertise for proposals for the construction of the system and that no contract shall be made by which a greater amount shall be agreed to be paid than the maximum amount stated in the petition, this objection fails; here. There is still another check provided by the statute (\{\frac{5}{287}}, 287 and 288, Town Law) as to the amount of money to be expended by the water commissioners.

Upon the execution of the contract for the construction of the system it becomes the duty of the district commissioners to notify the town board of the town as to the amount of money needed and the town board only can raise this necessary amount, which cannot exceed the maximum amount stated in the original petition.

The objection that the proposed plan will not provide a sufficient supply of water is more serious. The watershed is about twenty-three acres in extent, a portion of it is steep sidehill covered with low underbrush, another portion is steep sidehill cleared of brush from which rain water will run off very rapidly, and about one-half of the shed is swampy, covered with underbrush and swamp weeds. The two principal springs, upon which dependence is placed, were tested during the present summer (1910), and were flowing only about 4,000 gallons per 24 hours; the water was clear and cool, indicating a flowing spring rather than drainage from surface water; the other springs probably dry up in the summer. It is apparent that the district will have to depend upon stored water for at least four months in each year and unless the consumption is kept as low as forty gallons per capita per day the supply will not be sufficient for the entire year.

Examinations made of the territory surrounding the water district have failed to furnish any better supply than the one proposed, the alternative of driven wells and a pumping system would entail a greater first cost and operating expense than the size of the district would warrant. In view of the fact that this water district is without fire protection, that the buildings are almost entirely of frame and closely built up, and a conflagration would cause great suffering and damage, that for domestic purposes the inhabitants rely entirely upon some twenty-two private wells and upon private cisterns, and that serious suffering has already been caused by a shortage in these supplies, that it is the command of the statute, creating this Commission, that it shall make a reasonable effort to meet the needs of the applicant, it follows that this application should be approved.

The Commission, however, recommends that meters should be installed upon every service tap, in order to keep the daily consumption of water down to forty gallons per capita, the estimated safe yield of the sources of supply.

The State Water Supply Commission, therefore, finds and determines:

- (1) That the plans of the applicant for a new source of water supply are justified by public necessity.
- (2) That the plans of the applicant are just and equitable to other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.
- (3) That said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans, or the acquiring of said lands.

The Commission, therefore, approves of the plans of the applicant for a new source of water supply.

- IN WITNESS WHEREOF, THE STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Com-
- [L. s.] mission and caused its official seal to be affixed hereto and the same, with all maps, plans, surveys and other papers relating thereto, filed in its office in the city of Albany, this 30th day of November, 1910.

HENRY H. PERSONS,

President.

MILO M. ACKER, CHARLES DAVIS, JOHN A. SLEICHER, ROBERT H. FULLER,

Commissioners.

APPLICATION NO. 73.

SPENCERPORT. (Incorporated village.) Town of Ogden, Monroe county. Petition filed March 23, 1910.

Hearing held on April 14, 1910.

Village had no public system and depended on dug wells and cisterns for its supply of water.

Petition asked for approval of plan to drive a well, 12½ feet in diameter and 16 or 18 feet deep, in a gravel bank. This well when tested gave a supply of 82,000 gallons a day, to serve a population of 800. The pumping plant would consist of two pumps at the well, operated by gasolene engines, each 25 horse-power, connected with a single acting triplex pump, capable of pumping 350 to 400 gallons per minute. The water to be pumped to a standpipe, (cylindrical shell, 22 feet in diameter and 28 feet high, of riveted steel plate with hemispherical bottom and conical roof, supported on four columns) and situated 3,600 feet from well, and 70 feet above the main street, with a capacity of 100,000 gallons. Forty-six fire hydrants, double nozzle, 270 to 500 feet apart.

Analysis showed the water to be of fair quality although somewhat hard. Presence of B. Coli Communis not found in second sample.

Total estimated cost of project, \$39,000. The Commission approved the application May 10, 1910. Decision filed May 13, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the VILLAGE OF SPENCERPORT for the approval of its maps, plans and profiles for a new source of water supply.

Decision.

Application filed: March 23, 1910.

Hearing: April 14, 1910. Decision: May 10, 1910.

This matter came on for a public hearing at the library, village building, in the village of Spencerport, N. Y., on the 14th day of April, 1910.

William R. Barrett, Edwin J. Nichols and George P. Helfrich, trustees of the village, appeared for the applicant.

No objections were filed to the petition and no one appeared in opposition.

The village of Spencerport is a municipal corporation situate in the town of Ogden, Monroe county, about twelve miles south of Lake Ontario and about eleven miles distant from the city of Rochester. In 1905, its population was 753; since then this number has considerably increased. New buildings have been erected and a general condition of prosperity exists. The assessed valuation of the property within the corporation as appears from the last assessment-roll, is \$476,475. The total present indebtedness of \$7,200 was incurred for the construction of a municipal building and the annual budget for all purposes is about \$4,000.

The present water supply for domestic purposes is only such as is obtained from wells and cisterns upon private property. Those of the inhabitants who are without these, rely upon the generosity of their neighbors for a supply. The water in some of these wells has become contaminated and the use of them has been abandoned. For fire protection the authorities have relied upon some four or five cisterns, from eight to nine feet in diameter constructed below the surface of the streets; two of these are supplied by water from the roofs of adjacent buildings and the others by pumping from the Erie canal, which runs through the village. Property outside of the useful radius of these cisterns is without protection. Union street, the main thoroughfare of the village, is closely built up, nearly all of the buildings along the street as well as a very large majority of the residences are of frame construction. It is obvious that the protection afforded against loss by fire is very inadequate and consequently, fire insurance rates are high.

In 1909, an appropriation of \$400 was voted by the taxable inhabitants to defray the expenses of an investigation to ascertain the cost and location of a municipal water supply system. Hydraulic engineers were employed and the surrounding country was thoroughly looked over. It was found that a gravity supply could not be obtained. None were available or practicable, and upon the report of the engineers, and after due consideration by the board of trustees, a plan was adopted by which it is now proposed to take a supply from driven wells in a large gravel pit on the Cook farm, about a mile outside of the village limits, where it is designed to sink a well some 12½ feet in diameter and 16 or 18 feet deep. The elevation at this point is about fifty-five feet above the business section of the village but considerably less in other parts.

The water from the wells is to be pumped through an eight-inch force main to an elevated tank on Wilkinson's hill, some 530 feet south of the corporation line. The pumping outfit will consist of two independent units, each consisting of a twenty-five horsepower gasolene engine, direct connected, with a single acting triplex pump, capable of pumping 350 to 400 gallons per minute through the force main to the tank. The surface of the ground on the Wilkinson's hill is only about seventy feet above the business section and only about twenty-five feet above the residential section of the village and in order to obtain a suitable fire pressure, it will be necessary to erect a tank elevated some 100 feet. This tank is to be of 100,000 gallons capacity and it is assumed this will give a reserve supply sufficient to maintain three streams for a fire of two or three hours' duration. The tank designed is a cylindrical shell twenty-two feet in diameter and twenty-eight feet high of riveted steel plate, with hemispherical bottom and conical roof, supported on four columns.

A distribution system has been planned covering all the streets in the village, upon which forty-six double nozzle hydrants have been provided for at distances varying from 270 to 500 feet apart. The hyrdants are generally located at block corners so that most of the buildings can be reached by short lines of hose from at least three hydrants and it appears from the examination of the maps filed, that every building within the village will have fire protection from this system. The mains of the system consist of 3,890 feet of ten-inch pipe, 5,250 feet of eight-inch pipe, 14,226 feet of eix-inch pipe and only 1,850 feet of four-inch These sizes, considering the situation of the village and its financial ability, appear ample for domestic and fire service. A reduction in the sizes of some of the pipes would seriously impair the efficiency for fire protection. A pressure of about eighty-five pounds will be maintained at the hydrants in the business section with a full tank, or seventy-five pounds with the tank nearly empty. The maximum pressure in the extreme lower part of the village will be about ninety pounds and the minimum pressure at any hydrants in the high part of the village will be about sixty pounds.

Severe tests have been made to ascertain the quantity of water that could be obtained from the well at the Cook gravel pit. The first test showed 150 gallons per minute, pumping steadily for a week with two pumps in a dry time and on the second, pumping was continued for six days at the rate of approximately 82,000 gallons per day and at the end of the

test the level of the water in the well had not been reduced. Both of these tests were made with the well seven by five feet and approximately nine feet deep, not the full size or depth of the well as contemplated by the plans.

As soon as the village authorities had accepted the plans of the engineers as most practicable and available for the village, they submitted the plans to the inhabitants of the village and these maps and plans were on file at the office of the trustees prior to the general village election which was held on the fifteenth day of March, 1910, and at that election the following propositions were submitted to the electors qualified to vote thereon, namely:

- (5) "Shall \$38,988 be paid from money raised by tax or assessment to build a system of water works in the village of Spencerport?"
- (6) "Shall the village of Spencerport be authorized to borrow the sum of \$38,988, to be paid from money raised by tax or assessment, or so much thereof as shall be necessary, upon the bonds of said village, payable in twenty-seven equal annual instalments, the first of which shall be payable September 1, 1913, for the purpose of building and installing a system of water works in the village of Spencerport?"
- (7), "If the vote on propositions five and six is favorable, shall there be raised for preliminary expense of water works the sum of \$1,200?"

All of these resolutions were adopted by a full vote of the electors. Proposition No. 5 received 98 affirmative votes and 20 negative votes. Proposition No. 6 received 94 affirmative votes and 21 negative votes. Proposition No. 7 received 89 affirmative votes and 21 negative votes.

Since the election, no further objections to the plans as proposed have been made and no proceedings have been taken to set aside the vote or challenge the wisdom of the proposed plans as best suited to supply the necessities of the village, consideration being given to the elements of cost. The liberal detail estimates of the engineers show that the plant can be constructed for the amount appropriated by the electors.

The quality of the water from the well has also been submitted to several tests, both chemical and bacteriological. The first test that was made showed that the water to some extent was contaminated and that bacilli of the B. Coli type were present. In view of the fact that the well is dug in a very large gravel bank and that while the tests were being made cattle and men and horses were about the well, it is fair to assume that this contamination came from surface waters. The later tests show the absence of bacilli of the B. Coli type, though other bacteria were present; these later tests were also taken under adverse conditions; from the location of the well, and an examination of the surrounding territory, it is apparent that whatever contamination there is in the water must come from the physical surrounding, a condition that can be obviated as proposed by the plans. The water is of fair quality although somewhat hard, a defect that is found in all the ground waters of the locality. The water of this locality and of the well is not available for a domestic supply for any other municipality or civil division of the State.

The State Water Supply Commission therefore determines:

(1) That the plans proposed are justified by public necessity.

- (2) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.
- (3) That the said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the map of the lands to be acquired by the village of Spencerport for a new or additional source of water supply and the profiles thereof showing sites and areas of the proposed reservoirs and other works, the profile of the aqueduct lines and the flow lines of the waters when impounded, plans, surveys and abstracts of official reports relating to the same, and the plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of the said lands and the execution of said plans.

In Witness whereof, The State Water Supply Commission hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same, with all plans, maps, surveys, and other papers relating thereto, filed in its office in the city of Albany, this 10th day of May, 1910.

HENRY H. PERSONS,

President.

CHARLES DAVIS,

JOHN A. SLEICHER.

Commissioners.

APPLICATION NO. 74.

PLATTSBURGH. (City.) Town of Plattsburgh, Clinton county. Petition filed March 24, 1910.

Hearing held April 21, 1910.

Village taking water from West brook and Mead brook. Consists of a gravity system with two catchment reservoirs, also two distributing reservoirs, each 150 feet square with a capacity in each of 2,700,000 gallons. Fire hydrants in use. Cast iron or cement mains in nearly all streets.

Petition asked for approval of plan to build an additional reservoir on Mead brook with a capacity of 72,000,000 gallons, as the old dam was worn out. Population, 12,000.

Analyses showed the water to be unwholesome, moderately hard and bacteria of the B. Coli Communis type were present.

Total estimated cost of proposed project, \$40,000.

The Commission denied the petition May 20, 1910.

Decision filed June 2, 1910.

STATE OF NEW YORK-STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of THE CITY OF PLATTSBURGH for right to obtain an additional supply of water.

Decision.

Application filed: March 24, 1910.

Hearing: April 21, 1910. Decision: May 27, 1910.

The city of Plattsburgh has a gravity water supply system established many years ago and extended and improved from time to time as necessity required. The sources of the supply are two streams known as the Mead brook and the West brook, on both of which, six miles distant from the city, are catchment reservoirs; from these the water is conducted about $1\frac{1}{2}$ miles to a so-called well house, where the separate pipe lines are united and controlled, and from thence taken to twin, open, distributing reservoirs, each about 150 feet square, situate some three miles westerly from, and having an elevation of about 125 feet above, the city. From these open reservoirs, which when full hold about 2,700,000 gallons each, the water is sent by two pipe lines to the distributing system in the city limits. The streets of the city are nearly all supplied with either cast iron or cement mains and with fire hydrants well located.

The city was organized in 1902. Its population that year was 8,880. Its predecessor, the village of Plattsburgh, in 1890 had a population of 7,010, and in 1900, of 8,434. The city's population increased to 10,184 in 1905 and at the present time, the permanent population is variously estimated at from 12,000 to 13,000. Within the corporate limits there is a United States Government post, a State normal school and just outside, a large Catholic summer school and the Hotel Champlain. These establishments increase the resident population, especially during the summer vacation period, some 3,000, so that the city's water system is called upon to furnish a supply to from 15,000 to 16,000 people for domestic uses. Water is also furnished and in large volume to the Delaware and Hudson Railroad Company, the Plattsburgh Lumber Company, the Catholic Summer School and the Hotel Champlain; the two latter consumers being without the city limits.

The method employed by the city to support its water department and to derive a revenue from the use of water, is not entirely based upon the amount of water consumed by the user. While the large consumers, notably the United States Government, the Delaware and Hudson railroad, the Plattsburgh Lumber Company, the Catholic Summer School and the Hotel Champlain are metered, there are only forty-eight other meters installed upon the system. From all the other consumers a revenue is obtained by assessment based upon the assessed valuation of the property.

For example: Property valued at less than \$1,000 pays \$6 per year for water, valued from \$1,000 to \$2,000, \$8 per year; from \$2,000 to \$3,000, \$9 per year; from \$3,000 to \$4,000, \$10 per year; valued at \$4,000, \$11 per year and valued over \$4,000, \$12 per year.

This plan produces a gross annual revenue of from twenty-five thousand dollars to thirty thousand dollars per year, which is more than sufficient to pay interest, maintenance and operation charges and to retire the water bonds as they become due. The unmetered consumer is left free to use or waste an unlimited amount of water. That there is serious waste and an excessively high daily per capita use of water is evidenced by the fact that in the summer time nearly three million gallons per day is delivered through the system.

Plattsburgh now has a total bonded indebtedness of \$218,800, of which \$170,-600 was incurred for the water system, the assessed value of the property of the city being in 1909, \$3,395,895. The reservoir on the Mead brook was constructed about sixty years ago. Across the stream there is now an old earth and crib dam. This impounds about twelve milliom gallons of water, the watershed above the dam being seven square miles. During the year 1905 a concrete dam was erected on the West brook just west of the hamlet of West Plattsburgh, at an expense of nearly \$50,000, and a reservoir created which impounds 22,000,000 gallons. The watershed above this dam is eight square miles. The city delivers these waters to its inhabitants and consumers in a raw condition, no filtration of any kind is made and for a long time the quality of the water has been a matter of grave public and private concern. During the year 1906, several bacteriological tests were made of the waters of both brooks under the direction of the Surgeon-General of the United States Army. These tests demonstrated that the water was impure and an examination of the physical conditions disclosed the causes, namely: Cesspools, outhouses, barnyards and other sources of contamination along the banks and in the vicinity of the streams. Early in January, 1907, the board of health of the city made investigations of the lands in the vicinity of the West brook which was then the chief source of supply, the city having for some time prior virtually abandoned the Mead brook as a source of supply except in emergencies, and found several existing sources of pollution, and in a resolution adopted by it and presented to the board of public works and to the common council of the city, declared the existing conditions along the West brook to be a menance to the health of the people of the city and recommended that the authorities acquire the lands in the watershed of the West brook and that in the opinion of the board this action was necessary for the protection of the public health of the city. No question was raised at this time as to the sufficiency of the supply. The board of public works and the common council adopted the plan outlined by the board of health and on January 19, 1907, the city filed with the State Water Supply Commission an application to acquire certain lands in the watershed of the West brook from the crest of the divide east and west of said brook and from the new dam on the West brook to the head of said West brook in lot No. 61, Duerville patent. After due advertisement and a public hearing held on the 14th day of February, 1907, in the city of Plattsburgh, the State Water Supply Commission on February 27, 1907, made and filed its decision as required by law, wherein and whereby the application as presented was in all respects

approved. That determination of this Commission among other things said:

"At the present time it (Plattsburgh) takes its water from Mead brook and West brook. Situate upon the watershed of these brooks are many places of contamination. The nature and formation of the soil is such that after heavy rains, the water coming down from the steep hillside, through the farm yards, cess-pools, pig-stys, etc., carries into each of these streams a large amount of contaminating matter. The analyses which have been made from time to time, show that for these reasons the purity of the water is very much affected by heavy rain falls."

* *

"The watershed of West brook is covered with growing timber, although there are located along the stream many farms and buildings which are a constant source of contamination to the water supply of the city of Plattsburgh."

"The city, by this application, desires to abandon Mead brook as a source of supply and to purchase the entire watershed of West brook and remove therefrom every source of contamination and pollution. The analysis of water taken from this watershed, when uncontaminated, shows it to be an ideal potable water." * * *

"This application by the authorities of the city of Plattsburgh is a step in the right direction. It asks permission to own and control the watershed of West brook. Such a purpose on the part of the city of Plattsburgh, if it can be carried out, seems to the Commission to be most wise and commendable. The value of a pure source of water supply for a city cannot be too highly prized. The objection is often raised that the cost to a city of owning its own watershed is so great that it is practically prohibitive, but in this case the proof shows that the net profits of the present water system, in four or five years, will be sufficient not only to purchase the watershed of West brook, but to build a proper and sufficient storage dam. Any objection, therefore, from a cost point of view vanishes immediately. It is rare, indeed, that a city is so fortunate as to be able to purchase, without levying any additional burden whatever upon its inhabitants, such an ideal watershed, and to be able to say, not only to its own inhabitants, but to its summer visitors, in this case thousands in number, that it owns its entire watershed and that its water is absolutely free from foul and contaminating substances."

"It is also clear from the proof, that West brook, in ordinary years, will furnish sufficient water for the city of Plattsburgh, including the Catholic summer school, the United States government barracks and the Hotel Champlain; and when once it can say that its source is a pure source, it has greatly increased the attractiveness of that delightful region as a summer resort."

Nothing was done by the city to carry into effect this unqualified approval of its plan to safe-guard its water supply except that a special election of the city of Plattsburgh was held on the 7th day of April, 1907, for the purpose of voting upon the proposition contained in the following resolutions, namely:

"Whereas, This council and the board of health and the board of public works of this city have heretofore taken action to institute proceedings through the mayor and the corporation counsel before the State Water Supply Commission to acquire certain lands in the watershed of the West brook in the towns of Plattsburgh and Beekmantown for the purposes set forth therein;

"Resolved, That extraordinary expenditures ought to be made for the purpose set forth in the said resolutions and for the purposes set forth in the petition and application now before the State Water Supply Commission to acquire said lands in the watershed of the said West brook."

"Resolved, That it is the opinion of this council that in order to accomplish the purposes set forth in the said resolutions, petitions and applications, and to defray costs and expenses of acquiring the said lands in the watershed of the said West brook from the crest of the divide east and west of said brook, and from the new dam on the West brook to the head of the said West brook in lot 61 Duerville patent, that the sum of not exceeding \$50,000 shall be needed to acquire the said lands and to cover the costs and expenses of searches of title, condemnation proceedings and court proceedings and for the purchase of the said lands and for all costs incidental thereto; for the construction of such reservoir or reservoirs as may be deemed desirable to increase the city supply, and for such other purposes as may be necessary to increase, purify and protect the water supply of the city."

The whole number of ballots cast on the proposition was 187, of which 121 were in favor of the proposition, 62 against it and 4 blank or void ballots, and on April 15, 1907, the common council, meeting as a board of canvassers to canvass the vote of that election, declared the proposition adopted by the electors. Whatever reasons there were for further inaction on the part of the municipal authorities have not been disclosed.

The city now files a new application in which it alleges that by reason of the dilapidated condition of the present Mead brook dam, a large amount of water is wasted and that the supply from both brooks as derived from the present dams is not sufficient to furnish an adequate supply for domestic use and fire protection, especially during the summer months and desires authority to enlarge the present storage upon the Mead brook by building there a new reservoir of seventy-seven million gallons capacity and to acquire the necessary lands for such purpose. The new reservoir is proposed to be placed on the Mead brook above the old one, which it is to replace. The reason for making the change is that it is estimated to be cheaper to construct an entirely new reservoir than to attempt to rebuild the old dam and clean out the reservoir basin.

No maps or plans were submitted except a blue print showing the location and contours of the proposed new reservoir, estimated cost of the work being \$40,000.

Upon receipt of this application the usual notice of a public hearing was given to be held at the city of Plattsburgh on April 21, 1910, prior to which time objections were filed to the application by several of the property owners affected by the proposed construction, by citizens of the city, by the board of public works and the board of health of the city, the material objections being the general unsanitary condition of the watershed of the Mead brook and its tributaries, the near proximity of numerous sources of contamination, and the cost of removing which was beyond the means of the city and that there were plans offering more desirable re-

sults. Upon the hearing, the city appeared by John K. Collins, Esq., the corporation counsel. The objectors appeared in person. Testimony was given which shows that the quantity of water that is now derived from the West brook is not sufficient in times of drought for all the needs of the city, its inhabitants and customers outside of the city limits, and during such times of drought the available waters of the Mead brook are used to augment the supply from the West brook and that in the summer of 1909, street sprinkling was stopped and the citizens were notified to use water with caution.

On the Mead brook, the proposed source of additional supply, and in close proximity to the stream there are nine groups of buildings from which the surface water and barnvard drainage flows directly into the brook. In one instance, immediately above the proposed reservoir, the stream passes through a barnyard. In addition to these buildings, near the stream there are some twenty-five or thirty others in the watershed, the majority of which are located near the stream and which tend to the pollution of its waters. The lands through which this brook flows for two miles above the proposed reservoir are nearly all cultivated, meadow or pasture lands. The remainder of the watershed is covered with second growth timber and is rocky and rough side hill. The water of the stream is unwholesome. One capable witness said: "It was filthy," and another equally capable, described it as "nasty." The analysis made by the State Board of Health indicated the presence of a large quantity of undecomposed organic matter, evidently largely of vegetable origin as the chlorine value was very moderate and the color value somewhat high. The water contained large particles of suspended matter. The water was moderately hard, the hardness being mostly temporary in character and produced by bicarbonates of lime and magnesia. The bacterial count was high. Bacilli of the B-Coli type were present, and in fact the water is such as cannot be approved for use as a public supply.

In order to make this water pure and wholesome, one of two methods would have to be adopted. First, the acquisition and removal of all buildings, cattle yards, outhouses and other sources of contamination that are within the danger line along the stream. Second, the establishment and operation of a filter plant. Neither of these is provided for by the plans presented; nor is it contemplated that the amount of money proposed to be expended for the additional supply from the Mead brook will be sufficient to accomplish more than the construction of the proposed reservoir.

For these reasons, the present application of the petitioner is rejected. The plans proposed by this application are not justified by public necessity. It is proper to add here that under present conditions with practically an unmetered supply, with charges for water used, not governed by the amount of water consumed and with the burden on the plant of supplying water for railroad purposes and to consumers without the city, that the city of Plattsburgh needs more water during dry summer months than the system as at present constructed can produce and without a change in these conditions more water should be obtained, though the testimony shows that for all periods except these dry summer months, there is an abundant supply of water for fire and domestic purposes.

The West brook from which this supply is now entirely taken, has a larger watershed than the Mead brook and is largely covered by second growth timber. The land is rocky and large areas of it are untillable. The proximity of a few dwellings and barns near the banks of this stream is a possible source of contamination to this supply. The flow of the water in the stream is at least double that in the Mead brook and while the flow is greatly reduced during the summer months, the brook does not become dry at any time.

If the city of Plattsburgh will carry into effect the decision heretofore rendered upon the previous application and acquire the lands upon the West brook there described and do the work contemplated by that application, all of which it may do without further application, it can, with that watershed thus protected, obtain from the West brook an abundant supply of wholesome water sufficient for all its present needs and with proper storage and regulation sufficient for a city of 50,000 population.

As the present application is denied upon the ground that the plans as presented are not justified by public necessity, it does not become necessary to make the other determinations required by the statute.

The State Water Supply Commission does hereby reject the application of the city of Platteburgh entirely.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and rejection to be signed by the Commission and caused its official seal to be affixed hereto and the same with all plans, maps, and other papers relating thereto filed in its office at the city of Albany this 27th day of May, 1910.

HENRY H. PERSONS,

President.

JOHN A. SLEICHER, CHARLES DAVIS, State Water Supply Commission.

APPLICATION NO. 75.

CEOTON-ON-HUDSON. (Incorporated village.) Town of Cortlandt, West-chester county.

Petiton filed April 6, 1910. Tax election held later.

Hearings held July 15 and August 10, 1910.

Village had no public water supply system, taking its water from springs and dug wells.

Petition asked for approval of plan to take water from Croton river; an intake system of wells to be dug on north bank in gravel soil. Amount of proposed supply estimated at 100,000 to 750,000 gallons daily to serve a population of about 2500. Reservoir located in easterly part of village to be built of reinforced concrete founded on ledge rock, with a capacity of 750,000 gallons. Water to pass through a bed of sand and gravel. Pressures; maxi-

mum, 140 pounds; minimum, 60 pounds. Three and one-half acres of land to be acquired. Fire hydrants.

Analyses showed that water was soft, but there were present bacteria of the B. Coli Communis type.

Total estimated cost of proposed project, \$75,000.

The Commission approved the plan of the applicant August 24, 1910. Decision filed August 24, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the VILLAGE OF CROTON-ON-HUDSON for approval of its maps, plans and profiles for a new water supply system. Decision.

Application filed: April 6, 1910.

Hearing at Croton-on-Hudson: July 15, 1910.

Decision: August 24, 1910.

Nathan P. Bushnell, Esq., appeared for petitioner.

Frank L. Young, Esq., for water commissioners of village of Ossining. Franklin Couch, Esq., for Van Cortlandt estate.

Croton-on-Hudson was created a municipal corporation in 1896. It is situate on the east shore of the Hudson river, just north of the Croton river in the town of Cortlandt, Westchester county. Its population as shown by the village enumeration taken in 1906 was 1.713 and its estimated present population is upwards of 2,000. The assessed value of the property within the village is \$970,000 and its only debt \$1,500. Up to the present time the inhabitants have relied entirely upon wells and cisterns for municipal and domestic supplies. In June, 1910, the board of trustees of the village, who are its water commissioners, decided to install a municipal plant, and at a special election held in the village on the 21st day of June, 1910, the propositions to establish a municipal system for fire and domestic purposes at a cost of \$70,000 were practically unanimously adopted.

Following the examination, report and recommendation of its engineer, the Board of Water Commissioners of the village have proposed the following plan to carry out the wishes of its taxable inhabitants.

The supply for the village is to be obtained through tubular wells driven in the gravel and sand strata lying along the north bank of the Croton river at a point about 1,500 feet south of the new Croton dam of the city of New York and about 100 feet north of the Croton river; to unite the wells, build a pumping station and force the water through a 12-inch main to a reservoir of about 750,000 gallons capacity, from which the water will be drawn by 12 and 10-inch iron pipe lines to the distributing system, covering all the streets in the village and furnishing a fire protection at about 100

pounds pressure. To connect with the system approved fire hydrants located from 300 feet to 400 feet apart so that every building in the village but one will be protected.

The only land required to be taken will be about two acres for the pumping plant and one and one-half acres for the reservoir site.

The estimates of the total cost of the plant are within the amount appropriated by the village. The system will be capable of furnishing from 100,000 to 750,000 gallons per day as the needs and growing necessities of the community may demand.

As designed, this system has the approval of the Commission.

No objection was made or filed to the application as here presented. The village of Ossining, however, appeared by counsel upon the hearing and it was urged in its behalf that the taking of the proposed quantity of water from the watershed would injuriously affect the rights which the State Water Supply Commission had granted to that village in the Croton river by its determination under date of November 26, 1907, in the matter of the application of the village of Ossining for an additional supply of water. This objection was met by the testimony taken upon the hearing and by the results of subsequent stream gagings of the Croton river. From this evidence it appears that the new Croton dam of the city of New York, while it reaches an elevation of 200 feet above high water and goes down 100 feet below the surface and into the solid rock, with rock at both sides, does not prevent the seepage under this dam of a very large amount of underground water, variously estimated from four to five million gallons per day, and which finds its way into the Hudson river either through the Croton river or by underground courses. Below the Croton dam the river bed is free from water. It begins to show some 300 feet or 400 feet below it, bubbling up through the gravel. At a point about one-half a mile below the foot of the dam and opposite the place where the village of Croton-on-Hudson proposes to sink its wells there is a considerable stream of water. The gaging taken in August, 1910, shows, after a long continued dry period and without any water flowing over the Croton spillway, that more than two and one-quarter million gallons per twenty-four hours were flowing in the Croton river. Still further down the river and at the site of the proposed dam of the village of Ossining, the flow for the same time and period was more than two and one-half million gallons. Undoubtedly the underground flow is increased by the storage of the vast amount of water in the Croton reservoir. In no other way could the large flow of the Croton river below the dam be accounted for, the watershed of the river and of the small brooks which flow into the river below the dam would not under usual and general conditions be capable of producing so large a runoff in dry weather.

No municipalities or civil divisions of the State, other than Ossining, are affected by the plans of the applicant. Peekskill, on the north of Crotonon-Hudson, has an abundant water supply taken from other sources; Montrose is only a small hamlet with few houses, and for Yorktown Heights, with a population of about 800, unincorporated and distant some six miles to the east of the proposed pumping station, these waters are not available. There is abundant proof that the quantity of water available for Ossining

and Croton-on-Hudson in the Croton river and from the ground waters within the watershed of the Croton river below the Croton dam, is sufficient for a population many times that of Ossining and Croton-on-Hudson combined.

The so-called village or city of Harmon is not a municipality though streets have been laid out and some eight or ten houses erected and it has promising possibilities for growth and development; there is no demand for a municipal water supply. When such demand arises, these underground waters will undoubtedly furnish it an abundant quantity.

The proposed water is soft and pure and suitable in all respects for a municipal and domestic supply as is shown by the chemical and bacteriological investigations.

The State Water Supply Commission therefore determines:

FIRST: That the plans proposed by the village of Croton-on-Hudson for a new water supply system are justified by public necessity.

SECOND: That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

THIRD: That the said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the maps and profiles of the lands to be taken by the village of Croton-on-Hudson for a new water supply system and does hereby approve the application and plan of the said village, and the plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of the said lands and the execution of said plans.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the [i.s.] same with all plans, maps, surveys and other papers relating thereto, filed in its office in the city of Albany, this 24th day of August, 1910.

HENRY H. PERSONS,

President.

JOHN A. SLEICHER,
MILO M. ACKER,
CHARLES DAVIS,
ROBERT H. FULLER,
Commissioners.

APPLICATION NO. 76.

HARRISON. Water district No. 1. Town of Harrison, Westchester county. Petition filed April 19, 1910.

Hearing held May 6, 1910.

Village was formerly supplied from wells, installed and operated by West Harrison Water Company. The system consisted of a pumping plant, tank holding 20,000 gallons and distributing mains. These have become worn out and abandoned.

The petition asks for approval of plan to take water from springs in the vicinity of Silver Lake. The plans contemplate sinking a tank about fifteen feet in ground and consisting of two concentric steel cylinders perforated, the space between cylinders filled with gravel to act as filter. Pumping plant, triplex pumps, with a capacity of 105 gallons a minute. Elevated tank of 45,000 gallons capacity located on highest point in district connected with pump by an eight-inch main. Distribution mains from four to eight inches. One and one-half acres or more to be acquired.

Analyses showed the water to be good and potable.

Total estimated cost of project, \$40,000.

The Commission approved the plans of the applicant May 20, 1910.

Decision filed same date.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the HARRISON WATER DIS-TRICT No. 1, in the town of Harrison, Westchester county, for approval of its maps, plans and profiles for a new or additional source of water supply.

Decision.

Application filed: April 19, 1910.

Hearing at White Plains, N. Y., May 6, 1910.

Decision: May 20, 1910.

This matter came on for public hearing at the courthouse, in the village of White Plains, Westchester county, N. Y., on the 6th day of May, 1910.

Charles A. Dryer appeared for the applicant, and the applicant was also represented by the following-named members of the board of water commissioners of the said water district: Mr. Edward C. Gainsborg, president, and Messrs. Joseph Piskule and Max Winkler.

No objections were filed to the petition, and no one appeared in opposition. The applicant was duly established as the Harrison Water District No. 1 by resolution adopted by the town board of the town of Harrison, March 12, 1910.

The population of the water district, as shown by the evidence, is approximately 325, and its assessed valuation, as appears from the last assessment-roll of the town of Harrison, \$222,600. There are about sixty residences within the water district at the present time, most of them frame structures.

The water district was formerly supplied with water from a private system installed about seventeen years ago and operated by what was known as West Harrison Water Company. The supply was taken from wells and the system consisted of a pumping plant, a tank of a capacity of about 20,000 gallons and a distributing system in some of the streets. That plant became worn out and was abandoned, and the inhabitants of the district are now without a water supply either for domestic use or fire protection; the secretary of the West Harrison Water Company appeared in behalf of this petition upon the hearing and stated that the company were in favor of this application and would make no claim for damages.

The water district propose to install a new system by sinking a receptacle about fifteen feet deep to collect the water from springs in the vicinity of St. Mary's or Silver lake. This receptacle is to consist of two concentric steel cylinders, perforated, and the space between the cylinders to be filled with gravel to act as a filter. From this well, the water is to be pumped directly through an eight-inch main to a tank located on a steel tower on the highest point in the district. The pumps are triplex, with a capacity of 105 gallons per minute. The tank is to have a capacity of 45,000 gallons. The water is to be delivered to the district either direct from the pump or from the tank through mains ranging in size from four to eight inches.

The system is to be supplied with forty-five hydrants, which are considered sufficient to enable every residence in the district to be reached by the use of not more than 500 feet of hose. The pressure at each hydrant will be sufficient to afford ample fire protection for the entire district. The district is to acquire about an acre and a half where the springs are located and where the pumphouse is to be, and a sufficient amount of land where the tank is to be located.

Since this supply is taken from springs within the district, it does not appear that any other municipality or civil division will be affected by the carrying out of these plans, neither does it appear from the evidence taken on the hearing that there will be any instance of indirect damages.

While the establishment of the district provided that not to exceed \$100,000 might be used for the purpose of installing a water system, the evidence of the engineer indicates that they would not need to use to exceed \$40,000 at the present time. A \$40,000 bond issue on a valuation of \$222,000 appears excessive, but the evidence produced before the Commission indicates that there will be an increase in value of this district of about 40 per cent. in the next year and a half on account of the installation of this system and the necessities of the district seem to warrant the expenditure. A bacteriological and chemical analysis furnished indicate the water to be a good potable water for domestic purposes.

The State Water Supply Commission does hereby approve the application of the petitioner and hereby determines:

- (1) That the plans proposed are justified by public necessity.
- (2) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof,

particular consideration being given to their present and future necessities for sources of water supply.

(3) That the said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same, with all plans, maps, surveys, and other papers relating thereto, filed in its office in the city of Albany, this 20th day of May, 1910.

HENRY H. PERSONS,

President.

CHARLES DAVIS,
JOHN A. SLEICHER,
Commissioners.

APPLICATION NO. 77.

GREENWICH. Union Water Works Company. Towns of Greenwich and Easton, Washington county.

Petition filed April 29, 1910.

Hearing held May 11, 1910.

The Company is a private corporation organized in 1887, for the purpose of furnishing water to the village of Greenwich.

Present source of supply is Fly creek. Two reservoirs, the first one with a capacity of 7,000,000 gallons and the second 2,500,000 gallons. The distributing system consists of about 25 per cent. of eight-inch pipe, 35 per cent. of four-inch pipe, and 40 per cent. of six-inch pipe and fifty hydrants.

To increase the supply which for the past two years has been insufficient, the petition asked for approval of plan to build a third reservoir on Hill creek with a capacity of 30,000,000 gallons, also a filtration plant of the slow sand filtration type to be located at the reservoir. Gravity system.

Analysis indicated the water to be a good water for domestic uses. The bacteriological examination showed the presence of bacteria but no B. Coli.

Population, 2500.

Total estimated cost \$45,000.

The Commission approved the application May 11, 1910.

Decision filed May 11, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the GREENWICH UNION WATER WORKS COMPANY for approval of its maps and profiles of its proposed new reservoir and source of additional water supply.

Decision.

Petition filed: April 29, 1910.

Hearing: May 11, 1910.

Decision: May 11, 1910.

This matter came on for public hearing at the office of Van Ness and Maynard, in the village of Greenwich, Washington county, N. Y., on the 11th day of May, 1910. Van Ness and Maynard and also Henry Gray, president of the company, appeared for the petitioner. No objections were filed and no one appeared in opposition.

The Greenwich Union Water Works is a domestic corporation organized under the laws of the State of New York, in 1887, with a capital of \$30,000, to furnish water for domestic and fire purposes to the village of Greenwich, an incorporated village, having a population of about 2,500 people and located in the towns of Greenwich and Easton, Washington county.

The present property of the company consists of a distributing system in the village and two reservoirs. What is known as Number 1, was constructed about 23 years ago and has a watershed of one-half square mile and the reservoir capacity is 7,000,000 gallons. Number 2 was constructed about 12 years ago and has a watershed of five square miles and a storage capacity of about one-half million gallons. It is impossible to increase the storage capacity of reservoir Number 2 without interfering with the grade of the Johnstown and Gloversville railway. The elevation of reservoir Number 1 is 212 feet above the hydrant in front of the Hamilton House; Number 2 is 153 feet above the same point.

The distributing system consists of about 25 per cent. of 8-inch pipe, 35 per cent. of 4-inch pipe, 40 per cent. of 6-inch pipe and 50 hydrants, the location of which were fixed by the village board. During the past two seasons the supply of water has not been sufficient and the company has been obliged to make arrangements with manufacturing concerns in the village to pump water from the Battenkill into the mains. There has been serious objection to this because the water of the Battenkill is contaminated and not deemed proper water to use for domestic purposes without boiling.

The proposition of the company is to construct a third reservoir on what is known as the Hill brook, located 10,000 feet from the present pipe line, of 30,000,000 gallon capacity, which will be fed from a watershed 4½ square

miles. It is also proposed to protect the watershed from contamination to some extent and also to construct a filtration plant of the slow sand filtration type. This reservoir Number 3, it is estimated would furnish a supply for the village of Greenwich for 100 days in case no water was running in the stream. The elevation of reservoir Number 3 is 152 feet above the hydrant in front of the Hamilton House. It is proposed to bring water from reservoir Number 3 to the main system through a 12-inch cast-iron pipe. The estimated cost of the improvement is \$40,000 to \$45,000, and the company proposes to issue its bonds to secure the necessary funds. They also state they have arrangements made for placing the bonds.

It does not appear that any other municipality or civil division of the State will be affected by the taking of this water.

The analysis of the water indicates that with filtration, it will be a safe water for domestic purposes.

The State Water Supply Commission does hereby approve the application of the petitioner and hereby determines:

- (1.) That the plans proposed are justified by public necessity.
- (2.) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.
- (3.) That the said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.
 - IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the
 - [I.s.] same with all plans, maps, surveys and other papers relating thereto, filed in its office in the city of Albany, this 11th day of May, 1910.

HENRY H. PERSONS,

President.

JOHN A. SLEICHER,

CHARLES DAVIS,

Commissioners.

APPLICATION NO. 78.

BLACK RIVER. (Incorporated village.) Towns of LeRay and Rutland, Jefferson county.

Petition filed May 3, 1910.

Hearing held May 20, 1910.

Village has no public system of water supply and depends on wells and cisterns for their potable water. There is a system of four-inch wrought iron pipes laid in milling district for fire protection. This system is connected with pumps situated in the mills and takes water from the Black river.

Petition asked for approval of plan to take water from a spring, giving a supply of 100,000 gallons daily which with several other springs forms Drake creek. The plans propose building a dam across Drake creek and create, a small intake reservoir and install a pumping plant operated by electrical or other power with a capacity of 150 gallons per minute. Also to build a reservoir of 300,000 gallons capacity, 229 feet above village where the water not used will be stored. The distributing system consists of 9,000 lineal feet of four-inch cast iron pipe, 7,400 feet of six-inch, 1,600 feet of eight-inch, 4,500 feet of ten-inch, twenty-eight hydrants and necessary gates and valves.

Analyses showed the water to be potable if protected from the local contamination. There was a very moderate amount of organic matter present but no bacteria of the B. Coli Communis type.

Population, 1,000.

Total estimated cost, \$27,000.

The Commission approved the application May 20, 1910.

Decision filed June, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the VILLAGE OF BLACK RIVER for the approval of its maps, plans and profiles for a new and additional water supply. Decision.

Petition filed: May 3, 1910.

Hearing: May 20, 1910.

Decision: May 20, 1910.

The matter came on for a public hearing at Fireman's Hall, in the village of Black River, May 20, 1910, at 10 A. M.

William E. Brown, president of the village, and Water Commissioners H. C. Dewter, M. M. MacGruer and Fred W. Carpenter, appeared for the applicant.

No objections were filed and no one appeared at the hearing in opposition.

The village of Black River is located in the towns of LeRay and Rutland, in the county of Jefferson, and was incorporated under the General Village Laws in 1891. It has a population of about 1,000, and in 1909 the assessed valuation, exclusive of exemptions. was \$326,840. It has no present bonded indebtedness, and raises about \$2,000 annually for village expenses. The tax

rate is about \$7 per 1,000, and the property appears to be assessed at about one-third its actual value.

The buildings are largely of frame construction, and the village has some manufacturing plants consisting of a paper mill and chair factories.

The present domestic supply is entirely from wells. For fire protection they have what is known as a dry system, which consists of wroughtiron pipes laid on or near the surface of the ground, connected with factory pumps which pump water from the Black river in case of fire. If fires occur in winter, the water usually freezes in the pipes and renders them useless for the balance of the winter.

The village, at an election held September 28, 1909, voted to establish a municipal water system, and issue bonds for \$27,000 to defray the expense of same. The water commissioners propose to take water from a spring located about 7,200 feet from the center of the village near a small stream known as Drake's creek. This spring has a flow of 100,000 gallons per 24 hours, and the water is good potable water if protected from local contamination. There is also a second spring near this one of about the same capacity which could be easily connected with the system. Drake's creek, which these springs feed, has a flow of from 700,000 to 750,000 gallons per 24 hours. The waters of this creek are contaminated by the use of the lands adjacent to it for pasturage purposes. The Commission cannot authorize the use of the creek as a source of supply unless the village acquire the watershed and keep it free from contamination. The plan is to wall in the first mentioned spring to protect it from contamination and conduct the water into a small intake reservoir, install a pump of 150 gallons per minute capacity, and pump the water direct to the village and also to a reservoir of 300,000 gallons capacity, at an elevation of 229 feet above the village.

The distributing system consists of 9,000 lineal feet of 4-inch cast-iron pipe, 7,400 feet of 6-inch, 1,600 feet of 8-inch, 4,500 feet of 10-inch, 28 hydrants, and necessary gates and valves. The plan shows they are to have 9 dead-ends in their system, which is undesirable, but they seem unavoidable on account of the existing conditions.

It is apparent that if the village ever needs a greater supply than can be obtained from these springs, it could acquire the watershed of Drake's creek and have a supply sufficient for four times the present population.

It does not appear that the taking of this water will interfere with the present and future needs of any other municipality or civil division of the State, neither does it appear that there will be any indirect damages, on account of the taking of this water, to persons or property.

The analysis of the water indicates that with proper protection it will be safe for domestic purposes.

The State Water Supply Commission does hereby approve the application of the village and hereby determines:

- (1.) That the plans proposed are justified by public necessity.
- (2.) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

(3.) That the said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans, or the acquiring of said lands.

In witness whereof, The State Water Supply Commission hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same, with all plans, maps, surveys and other papers relating thereto, filed in its office in the city of Albany, this 20th day of June, 1910.

HENRY H. PERSONS,

President.

CHARLES DAVIS,
JOHN A. SLEICHER,
Commissioners.

APPLICATION NO. 79.

BELFAST. Water District. Town of Belfast, Allegany County. Petition filed May 26, 1910. Hearing held on June 14, 1910.

The village has no public water supply system, depending on wells and springs, and for fire protection there is a hand engine which pumps water from several cisterns. The Water District, established January 12, 1910, has a population of about 1,000.

Petition asked for approval of plan to obtain water from driven wells, situated a mile and a quarter from and 187 feet above village. Test wells have been driven which showed a yielding capacity of 360,000 gallons daily. A concrete reservoir will be located near wells with a capacity of 300,000 gallons. Water to be piped to water district through an eight-inch cast iron main and six-inch and four-inch pipe to be used in distributing system connecting with thirty-four hydrants. Maximum pressure, eighty-one pounds. Minimum pressure, seventy-eight pounds.

Analyses showed the water to be satisfactory for domestic purposes. Total estimated cost of project, \$30,250.

The Commission approved the application July 7, 1910.

Decision filed July 7, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the WATER COMMISSIONERS OF THE WATER DISTRICT OF THE TOWN OF BELFAST, ALLEGHANY COUNTY, for the approval of its maps, plans and profiles for a new or additional source of water supply.

Decision.

Petition filed: May 26, 1910.

Hearing: June 14, 1910.

Decision: July 7, 1910.

This matter came on for public hearing at Fireman's Hall in the village of Belfast. June 14, 1910.

Edward Rutherford, Esq., attorney, appeared for the applicant, and Water Commissioners P. F. Loftus, George J. Fisk and H. B. Van Vleet also appeared.

No objections were filed and no one appeared in opposition.

Evidence was presented showing that the town board of the town of Belfast on petition of the majority of the inhabitants established the Belfast Water District, comprising about one square mile, January 12, 1910. The boundaries of the district are substantially the boundaries of the unincorporated village of Belfast, which has a population of about one thousand. It appears that the assessed valuation of the property within the water district for 1909, is \$244,595 and that the tax rate is about \$11 on \$1,000. It also appeared that the water district or town have no present bonded debt. The water district consists largely of residences with one or two small manufactories and the buildings are mostly of frame construction.

In August of 1909, the village suffered a very disastrous fire which resulted in a loss estimated at \$50,000 to \$60,000.

The present supply of water for domestic purposes is entirely from wells and springs. A few cisterns in the streets which are supplied from the roofs of adjacent buildings furnish the supply for fire protection. Their fire apparatus consists of one old-fashioned hand engine. It appears from the evidence that many of the inhabitants have no wells on their property but are obliged to go to their neighbors for water for domestic purposes. It is very apparent that this district is in need of a better water supply.

The petition of the taxpayers of the water district provided for the expenditure of \$45,000 to establish the water system.

The application before this Commission proposes a plan which is to cost only about \$31,000. The plan proposed by the petitioner is to sink deep wells on a hill about one mile from the center and at an elevation of 187 feet above the village and to pump the water from these wells into a reser-

voir, situate near the wells, with a capacity of 300,000 gallons and to pipe it to the water district through an eight inch cast iron main and to use in their distributing system six and four-inch cast iron pipe. It is proposed to locate thirty-four hydrants in the district, which will be so located that they will be within 500 feet of every building in the district with the exception of one or two in the outlying territory. The pressure at the hydrant in the center of the district will be 81 pounds to the square inch and at the highest hydrant in the district, it will be 78 pounds. The proposition is to sink five wells and the evidence shows that with the installation of the proposed pumps, they can furnish 360,000 gallons in twenty-four hours.

If the engineer's plans are carried out, it will undoubtedly furnish a good gravity service for this district. The analysis shows the water to be of good quality for domestic purposes.

It does not appear that any other municipality or civil division of the State will be affected by the taking of this water.

While the petition does not provide for the payment of indirect damages, neither does it appear that there will be any, however, the president of the water board stated, under oath, that in case any claim for indirect damages arose, the board or their counsel, would not object to the introduction of evidence showing same.

The State Water Supply Commission does hereby approve the application of the water commissioners of the water district of the town of Belfast and hereby determines:

- (1.) That the plans proposed are justified by public necessity.
- (2.) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.
- (3.) That the said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans, or the acquiring of said lands.
 - IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Com-
 - [L. s.] mission and caused its official seal to be affixed hereto, and the same, with all plans, maps, surveys, and other papers relating thereto, filed in its office in the city of Albany, this 7th day of July, 1910.

HENRY H. PERSONS,

President.

CHARLES DAVIS,
JOHN A. SLEICHER,
Commissioners.

APPLICATION NO. 80.

MORAVIA. (Incorporated village.) Town of Moravia, Cayuga county. Petition filed July 6, 1910.

Hearing held July 22, 1910.

Present source of supply of village is from springs in towns of Summerhill and Locke and one in town of Moravia. A reservoir is situated on the hillside east of the village at such an elevation as to maintain a pressure in the main streets of seventy-five pounds per square inch. It is constructed of masonry and is 112 feet by 72 feet and 12 feet deep with a capacity of 700,000 gallons and the water from the springs is conducted into it through three-inch and four-inch pipes. A ten-inch pipe connects the reservoir with the main distributing pipes and the system is well equipped with fire hydrants, valves, etc. The pipes are of cast iron and consist of 12,700 feet of four-inch pipe, 1,440 feet of six-inch pipe, 1,000 feet of eight-inch pipe and 2,200 feet of ten-inch pipe. When supply was insufficient, water has been pumped from driven wells which are subject to contamination. There is no filtration plant.

Petition asked for approval of plan to purchase springs on the farm of Lamar Close, conduct water through pipes to a small concrete reservoir and from there through a three-inch pipe to the pipe leading to distributing reservoir. To protect springs from surface drainage, a concrete or other tight masonry curb is to be built around them with concrete top and locked iron manholes.

Chemical and bacteriological examinations of the springs show them to be pure and free from bateria of the B. Coli Communis type and of a degree of hardness not objectionable for domestic use.

Total estimated cost of proposed project, \$3,500.

The Commission approved the application August 24, 1910.

Decision filed August 24, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter

of

Decision.

The Application of the VILLAGE OF MORAVIA to acquire an additional water supply.

Application filed: July 6, 1910.

Hearing: July 22, 1910.

Decision: August 24, 1910.

On July 6, 1910, the village of Moravia filed with the Commission an application for the approval of its maps and profiles for an additional source of water supply for that village. Pursuant to the public notice given on July 7, 1910, and published in the Moravia Republican Register, the Commission met at the First National Bank in the village on July 22, 1910, for the purpose of hearing all persons and municipalities affected by the application.

Taber and Brainard (Mr. F. P. Taber) appeared as attorneys for the applicant. Mr. John P. O'Hara, president of the village, and Messrs. Tuttle, Ward and Cady, trustees of the village, also appeared in person. No objections were filed.

The village of Moravia is situate in the town of Moravia, Cayuga county, upon a small creek known as Owasco inlet, four miles southerly of Owasco lake and upon the watershed adjacent to that lake.

The village was incorporated as early as 1837 by special act of the Legislature, reincorporated in 1859, its charter revised in 1891, and in 1908, by a vote of its inhabitants, became a village under the General Village Law.

The population, according to the enumeration of 1905, was 1,489. It is not estimated at more than that number at the present time. In fact, there has been no substantial increase since 1890, when the enumeration showed 1,486 inhabitants. The township of Moravia has, however, increased in population during the period named, 1890–1905, from 1,881, in 1890, to 2,315, in 1905. No new buildings have been erected in the village, with possibly one exception, during the past four or five years. There is but one manufacturing establishment, and the general business of the village is supported almost entirely from the surrounding farming district.

In 1885 the Moravia Water Works Company constructed a water system to supply the village and its inhabitants and continued to own and operate the plant until May 1, 1910, when the village purchased the property of the company for \$36,500. At the time of its purchase this property comprised a distributing system in the streets of the village, a storage reservoir and site, several springs, pipe lines, rights of way and an auxiliary pumping plant, land and wells. The distributing pipes are all cast iron and consist of 12,700 feet of 4-inch pipe, 1,440 feet of 6-inch pipe, 1,000 feet of 8-inch pipe and 2,200 feet of 10-inch pipe, the latter extending from the reservoir down to the street system, connected with which are thirty-two hydrants and the usual valves and gates. The reservoir is situate on the hillside east of the village and within the village limits. It is constructed of masonry and it is 112 feet by 72 feet and 12 feet deep. Its capacity is about 700,000 gallons, about one week's supply, and gives a pressure in the flat portion of the village of about 75 pounds per square inch and is so constructed that the surface drainage cannot find its way into it.

The springs, the sources of supply, are five in number. One is located in the town of Moravia about one mile east of the reservoir and four are in the adjoining town of Summerhill, about four miles southeast of the village. These springs are each enclosed within rubble masonry walls, covered with flat wooden roofs, notwithstanding which they have been and still are liable to contamination from surface waters and drainage from many sources of pollution in the immediate surroundings. The water from the springs is piped to the reservoir through 1,200 feet of 2-inch pipe, 15,200 feet of 3-inch pipe, and 1,500 feet of 4-inch pipe. During part of each year these springs have delivered sufficient water to supply the needs of the village and there have been times when the waters in the reservoir over-

flowed, but each year, during the dry period, they fail to furnish an adequate supply. The superintendent of the water company, who has been in charge of the system for ten years past, testified: "We never have had quite enough water."

When the yield of these springs has been insufficient, the supply has been augmented, at a cost of about \$300 per year, by pumping water directly into the mains from driven wells situate in the northwest part of the village west of the railroad tracks, and in the flat valley of the Owasco inlet, which is subject to more or less flooding and contamination. There are two 4-inch wells, one driven to a depth of 42 feet and the other to a depth of 150 feet. The water in each of these is very hard and rises to within two feet of the surface.

The Water Works Company furnished about 250 places with water through about 220 taps. Allowing five persons to each family, there are now about 1,250 water consumers, and as there is no great industrial consumption of water, a fair per capita use of 100 gallons daily would mean that 125,000 gallons should be put in the reservoir every twenty-four hours. It is quite evident that the springs do not at all times furnish this quantity of water. though it is an actual fact that at times when the springs furnish enough water to keep the pipes flowing full, the reservoir overflows. The water from the system has been furnished to the consumers without filtration of any kind. In February and March of 1910 the village experienced an epidemic of typhoid fever; some twenty-nine cases developed in the village and the surrounding territory. The local authorities caused examinations to be made of the physical condition of the water supply and chemical and bacteriological examination of the spring water, and it was found that the situation of the spring was such as to invite rather than ward off pollution, and that the water was highly contaminated, bacteria of the bacillus coli communis type being present in almost every test. On February 26 the board of trustees of the village decided to submit to the electors of the village the following proposition: "Shall the village of Moravia issue bonds in the sum of \$40,000 for the following purposes: \$36,500 for the purchase of the Moravia Water Works system and \$3,500 for necessary improvements to said system "- and at the village election held on March 15, 1910, the propostion was adopted by a vote of 117 in favor of to 67 against the same. Following this vote and in conformity therewith the plant and property of the water company was purchased, and on May 1st of this year taken into the custody and control of the village authorities.

Immediate steps were taken to protect and improve the water supply, the use of several of the smaller springs was discontinued and new concrete curbs built around the two best springs for conserving all of the water that it is possible to obtain from them and for the further purpose of protecting them against contamination from surface water. The trustees decided to abandon the use of the wells in the village and to obtain an additional supply from some other source, and after investigation and report from its engineer this application was made for the purpose of obtaining an additional supply from springs situate in the adjoining town of Locke and within a short distance of the present intake pipes.

The proposed new source of supply is a series of springs on the farm of Lamar Close, situate on the south side of the Dry Creek valley and about

two and one-half miles from the village reservoir and about one mile southwesterly from the old springs situate in the town of Summerhill. It is proposed to lead the water from these new springs through pipes to a collecting basin or small concrete reservoir and from the latter to lay a 3-inch pipe connecting with the present 3-inch pipe leading to the distributing reservoir.

Following the hearing held by the Commission in the village of Moravia it has caused an examination of the present system and the proposed new source of supply and the maps, plans and profiles of the village to be made by its engineer, whose report upon the subject has been filed in the office of the Commission.

Chemical and bacteriological examinations of the waters of the proposed springs show them to be pure and free from bacteria of the bacillus coli communis type and of a degree of hardness which will not render them objectionable for domestic use.

Upon the Close farm are nine springs. In August, 1910, four of the nine were entirely dry; the other five were flowing. When gaged in May, 1910, by the village engineer the yield was found to be 60,000 gallons per day. The present nonflowing streams appeared to be outlets for surface drainage only in winter and spring or after heavy rains and it is not advisable that the village shall attempt to use these so-called springs.

The temperature of the water taken from the flowing springs is about 40 degrees, and from engineer's report it would appear that but two of the springs are safe for the village to use, and then only provided a proper concrete or other tight masonry curb is built around them with a concrete top and locked iron manholes, and due precaution taken to exclude all possibility of surface drainage getting into the water. The other three flowing springs are probably safe for use and could be used if it is found that the other two are not sufficient to make up the deficiency in the present needs of the village, provided the same precautionary measures are taken to protect them from surface pollution. While there is evidence to show that the village has not spared expense in its endeavor to protect two of the old springs from contamination and that the work has been well done, no safeguards whatever have been provided for the other one of the old springs, known as the Harris spring. The plans of the village for its additional supply are, therefore, modified so as to provide the same plan for protecting the Harris spring as has been employed at the other two old springs, and also so as to provide for concrete tops with locked cast iron manholes in place of the wooden ones over all the old springs.

Owasco inlet rises in Tompkins county and flows some sixteen or seventeen miles northerly to Owasco lake. It is a small creek and along its course are several small neighborhood communities and the villages of Croton, Locke and Moravia. Its waters are not used for domestic or power purposes and it probably serves as a drainage outlet of the southern portion of the watershed adjacent to Owasco lake. This lake is about eleven miles long and is the source of water supply of the city of Auburn. The village of Moravia has no sewage system. Cesspools are in general use, though there are some properties that have direct connection with the inlet.

The assessed valuation of the village of Moravia is \$639,538 and its bonded debt, including the bonds issued for the purchase and improvement of the

water supply system is \$49,000. The waters of the springs proposed to be taken by the applicant are not available to other municipal corporations or civil divisions of the State, nor are these waters now used for any purpose whatever. They help form the head waters of the Dry creek, a tributary of the Owasco inlet. Included in the cost of the proposed new work is the sum of \$500 for the purchase of the land upon which the springs are situate and for the diversion of the water from the land of the owner.

'the State Water Supply Commission therefore determines:

FIRST: That the plans proposed by the village of Moravia for an additional supply of water as herein modified are justified by public necessity.

SECOND: That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

THIRD: That the said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the maps and profiles of the lands to be taken by the village of Moravia for an additional source of water supply and does hereby approve the application and plan of the said village, with the modifications thereof, as hereinbefore set forth and which modifications it determines to be necessary to protect the water supply and interests of the applicant and the plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of the said lands and the execution of said plans.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same, with all plans, maps, surveys, and other papers relating thereto, filed in its office in the city of Albany, this 24th day of August, 1910.

HENRY H. PERSONS,

President.

CHARLES DAVIS,

MILO M. ACKER,

JOHN A. SLEICHER,

ROBERT H. FULLER,

Commissioners.

APPLICATION NO. 81.

CANAJOHARIE. (Incorporated village.) Town of Canajoharie, Montgomery county.

Petition filed July 13, 1910.

Hearing held July 26, 1910.

Village had been furnished with water by the Canajoharie Water Supply Company, but supply has been inadequate and unsatisfactory. In June, 1909,

the village applied to this Commission for permission to take water from Sprite creek, located about twelve miles northeasterly and at an elevation of about 700 feet above village. The creek is formed by springs and the supply of water is abundant and ideal for domestic use. The water is to be conducted through wood pipes to a reservoir located in the center of farm of Charles H. Groff with a capacity of five million gallons, and a large main will carry water to the distributing pipes.

The petition asked for approval of plan to change the location of the reservoir and pipe line, and involved the acquiring of lands not contemplated in previous application. Reservoir is to be located on the northeastern corner of the same farm, a more convenient and advantageous location, the creek being suitable and accessible for cleanout and overflow pipes. The change in the conduit line will necessitate a larger size of pipe, but 2,000 feet less than originally planned. There is also a saving in the cost of procuring the right of way and the construction cost.

Total estimated cost of project, \$150,000.

The Commission approved the application August 10, 1910.

Decision filed August 11, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of THE TRUSTEES OF THE VIL-LAGE OF CANAJOHARIE, Montgomery County, N. Y., for the approval of a proposed amendment or modification of maps, plans and profiles of proposed water supply system, and the source thereof.

Decision.

Application filed: July 13, 1910.

Hearing: July 26, 1910.

Decision: August 10, 1910.

This is an application by the village of Canajoharie for approval of the following proposed modifications of its original plan to supply its inhabitants with water, viz.:

A change in location of the storage reservoir, a relocation of a part of the conduit line and a consequent and necessary increase in the size of the pipe line.

These modifications involve the acquiring of lands not contemplated by the original plan which was approved by the Commission on March 10, 1910.

The reservoir as originally located was situate very nearly in the center of the farm of Mr. Charles H. Groff, and within a short distance of his buildings. The new location is in the northeastern corner of his farm in a triangle formed by two highways and a creek, a much more convenient and advantageous location, the creek being suitable and accessible for cleanout

and overflow pipes, and very much more satisfactory to Mr. Groff and more economical to the village.

The change in the conduit line being some 2,000 feet shorter than the original line and following the highway for upwards of three miles is for economy in the matter of right of way and construction cost, though the relocation of the reservoir and the conduit line as proposed necessitates an increase in the size of the pipe line.

No municipal or civil division of the State will be affected by the proposed changes other than those affected by the original plan.

Notice of the hearing was given in both the local papers of the village of Canajoharie pursuant to order of this Commission, and the village authorities caused a notice of the hearing to be mailed to each one of the property owners affected by this application.

No objections were made or filed to the application and no person appeared at the hearing in opposition.

This application should be granted.

DECISION.

The State Water Supply Commission therefore determines:

That the modification of the maps, plans and profiles herein proposed by the village of Canajoharie is justified by public necessity. Such modified plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply, and that such plans make fair and equitable provision for the determination and for the payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans.

The State Water Supply Commission does hereby approve the modified plans filed with it on July 13, 1910, and accompanied by a map of the lands to be acquired by the village of Canajoharie for a new or additional source of water supply and profiles thereof, showing sites and areas of the proposed reservoir and other works, the profile of the aqueduct line, and the flow lines of the waters when impounded, and plans, surveys and abstracts of official reports relating to the same.

- In witness whereof, The State Water Supply Commission hath caused this determination and approval to be signed by the Com-
- [L. s.] mission and caused its official seal to be affixed hereto, and the same with all plans, maps, surveys and other papers relating thereto filed in its office in the city of Albany, this 10th day of August, 1910.

HENRY H. PERSONS,

President.

ROBERT H. FULLER, JOHN A. SLEICHER, MILO M. ACKER, CHARLES DAVIS,

Commissioners.

APPLICATION NO. 82.

Youngstown. (Incorporated village.) Town of Porter, Niagara county. Petition filed July 20, 1910.

Hearing held August 5, 1910.

Village has no public system and takes water from private wells. No fire protection.

The petition asked for approval of plan to take water from Niagara river, forty feet from shore. Pumping plant to consist of two power pumps, 15 H. P. gasolene engines, capacity of each 200 gallons a minute; equivalent to 288,000 gallons in 24 hours. Pressure of 100 pounds per square inch. Purification plant, a horizontal steel pressure filter, 200 gallons a minute. Water to be pumped to distributing mains and a standpipe of steel built on substantial stone or concrete foundation, 10 feet in diameter and 100 feet in height; situated in southeasterly corner of village. The distributing system of pipes consists of 8-inch, 6-inch and 4-inch cast iron pipes and 36 fire hydrants.

Population approximately 600.

Total estimated cost of proposed project, \$23,000.

Commission approved the application August 24, 1910.

Decision filed August 26, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the VILLAGE OF YOUNGSTOWN for the approval of its maps and plans for a new and additional source of water supply and for the construction of a water works system.

Decision.

The application in these proceedings, accompanied by the maps, plans and specifications for a water works system, was filed with the Commission on the 20th day of July, 1910.

Notice for a hearing to be held thereon at the office of the village clerk, in the village of Youngstown, on the 5th day of August, 1910, at 10 o'clock in the forenoon of that day was given. Such notice was published as provided by law.

The matter came on for a hearing on the 5th day of August, 1910, at the time and place stated in the notice. The hearing was adjourned to Eldorado Hotel, Youngstown. The village appeared by its officers Mr. J. W. Falkner, president of the village, and gentlemen Miles G. Wellman and Ludwig Pierson, trustees of the village.

No objections to the application were filed with the Commission and there were no appearances in opposition thereto.

The village, by its representatives, filed proof of publication of the notice of hearing.

The proof given at the hearing shows that Youngstown, a village of 700 people, steadily, though not rapidly, increasing in population, is situate in Niagara county on the Niagara river and has an assessed valuation of \$255,966.

By reason of its attractive surroundings and its proximity to the Niagara river, nonresidents, in yearly increasing numbers, spend some portion of the summer months there.

At the present time, water for domestic purposes is obtained wholly from wells sunk into the ground a distance of about 30 feet. It has no fire apparatus nor fire protection except such voluntary bucket service as may be quickly organized at times of fire. In the business section of the village, the insurance rate is \$32.50 per year per \$1,000.

The question of installing a water plant for this village was submitted to a vote of the people on the 28th day of October, 1909. The result of the vote was a majority in favor of establishing the water plant.

The village proposes to take its water from a point in the Niagara river about 20 feet out in the channel from the shore. Their plan is to purchase sufficient land and install a pumping station and filtration plant and pump the filtered water into a stand-pipe situate near the center of the village and high enough to give 45 pounds pressure. This stand-pipe, having a capacity of 60,000 gallons, is to be connected with the distribution system which carries the water to all parts of the village and includes a sufficient number of hydrants to give ample fire protection.

The plant as designed will cost about \$23,000 and bonds have been issued in that amount.

It is the purpose of the village to use the money raised by these bonds to build and equip the plant and pay all damages that may accrue to persons or property, either direct or indirect, which will result from the acquiring of the necessary lands and the execution of said plans.

The proof also shows that the execution of the plans of the applicant herein will not in any manner interfere with any other municipality or civil division of the State or the inhabitants thereof, giving due consideration to their present and future necessities for sources of water supply.

It is well known that the Niagara river water, receiving as it does the sewage and waste from cities and villages farther up the stream, is not of a quality that commends itself for potable purposes. This objection, however, to taking water from Niagara river is overcome by the fact that the plans of the applicant provide for a steel pressure filtration plant with a capacity of 200 gallons per minute guaranteed by the manufacturers to do its work to the satisfaction of the village officers. It is now generally conceded that with proper filtration, the waters of Niagara river may be safely used for potable purposes.

The abundance of the flow of this stream is of itself evidence that the plans of the applicant will not in any manner affect any other municipalities or civil divisions of the State or the inhabitants thereof, particular considera-

tion being given to the present and future necessities of sources of water supply.

The necessary permission for the applicant to take water from the Niagara river for the purpose of establishing this proposed plant has been obtained from the War Department of the United States Government. An investigation made by the engineer for the village shows that there is no other available source of water supply for this community.

The fact that this village, growing in population, and having no water system except wells which are liable to become contaminated, and receiving into its midst summer visitors in increasing numbers, is further evidence that the plans and specifications of the applicant are justified by public necessity and should receive the approval of this Commission.

The Commission, therefore, finds and determines:

FIRST: That the plans proposed by the applicant are justified by public necessity.

SECOND: That such plans are just and equitable to other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

THIRD: That such plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans, or the acquiring of said lands.

FOURTH: The Commission does hereby approve the maps and profiles for a water plant filed by the village of Youngstown with its application in these proceedings.

IN WITHESS WHEREOF, The STATE WATER SUPPLY COMMISSION has caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same, with all the maps, plans, specifications, surveys and other papers relating thereto filed in its office in the city of Albany, this 24th day of August, 1910.

HENRY H. PERSONS,

President.

JOHN A. SLEICHER, MILO M. ACKER, CHARLES DAVIS, ROBERT H. FULLER, Commissioners.

APPLICATION NO. 83.

HORNELL. (Incorporated city.) Town of Hornell, Steuben county.

Petition filed August 4, 1910.

Hearing held August 17, 1910.

City has a water works system constructed in 1982, which has been enlarged and expanded. The supply is taken from Seeley creek and Grover river which drain a watershed of twelve square miles. A reservoir located on Seeley creek has a capacity of 46,000 gallons. Mechanical filters have been installed. A 16-inch cast iron pipe connects reservoir with filter and filters with distribution mains. City has been growing steadily and the capacity of the present reservoir is insufficient.

The petition asked for approval of plan to construct another reservoir on Seeley creek above present reservoir. To be formed by the construction of a dam and embankment across the valley of creek, and to have a capacity of 110,000,000 gallons. Reservoir to be filled during freshets and held in reserve for dry weather. 146 acres to be acquired. Plans also propose to lay a new eighteen-inch cast iron main from present reservoir to distribution system.

Analyses showed the water to be suitable for domestic use. Bacteria of the B. Coli type were not present.

Total cost of proposed improvement, \$100,000.

The Commission approved the application August 24, 1910.

Decision filed August 26, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the CITY OF HORNELL by and through its Board of Public Works for permission to make extensions to its present water supply and for the approval of its maps and profiles.

Decision.

On the 4th day of August, 1910, the city of Hornell, by its Board of Public Works, filed its application for a new and additional source of water supply; for permission to extend its present water plant and for the approval of its maps and profiles therefor.

Accompanying this application was the report of its superintendent of public works and maps, plans and profiles, showing the lands to be acquired and the reservoir to be constructed.

A notice for hearing upon this application was given to be held at the City Hall in the city of Hornell on the 17th day of August, 1910. This notice was published as the law provides.

On the 17th day of August, 1910, the Commission met pursuant to such notice at the time and place therein stated. The city appeared by its attorney, Francis M. Cameron, and by the members of the Board of Public Works, to wit.: Charles G. Kelly, C. W. Etz, James E. Schwarzenbach and W. W. Babcock.

The city attorney filed a proof of the publication of the notice. An adjournment was then taken to the office of the Board of Public Works of said city, where the hearing was held and the testimony taken, after which the Commission inspected the site of the proposed reservoir and the lands proposed to be purchased.

The city of Hornell purchased its present water plant from a private company September 1, 1901, for \$300,000.

In the nine years of city ownership those having charge of the plant have reduced the bonded indebtedness from \$300,000 to \$248,000, or \$52,000. They have also extended the distribution mains and otherwise improved the plant at a cost of nearly \$100,000, besides reducing the rate charged for water rentals 20 per cent.

The net yearly income of this plant, after deducting all charges for upkeep, extension, repairs and improvements, cost of operation and interest on the outstanding bonds, is from \$12,000 to \$15,000.

The city has a population of about 14,000 and is steadily growing. There is also a constant increase in the consumption of water. The reservoir of the present plant is situate nearly five miles from the city and at an elevation which gives a sufficient pressure for fire protection.

This reservoir is connected with the filter plant and the filter plant with the distribution mains in the city by a 16-inch cast-iron pipe. The city owns the lands surrounding the reservoir and also a strip of land on each side of Seeley creek, the stream running into the reservoir for a distance up the creek for nearly one mile. There are at present nearly three thousand consumers of water in the city besides 165 fire hydrants. During the past few years, on account of the size of the present reservoir, the superintendent has been compelled to, and has restricted the consumption of water in the city during the dry months of the year.

Included in the city's plant is a mechanical filter which has done its work well, as the proof shows during the past seven years and probably for many more that not a single case of typhoid fever has been traceable to the city water. The analysis of the sample of the water taken from the source of the proposed addition and filed with the application in these proceedings shows that the water is free from deleterious substance.

The plan of the Board of Public Works of the city of Hornell is to buy a farm of 146 acres situate upstream from the present reservoir and adjacent to the strip of land which the city now owns and lying on each side of Seeley creek, and build a new reservoir with a capacity of 110,000,000 gallons, fill it during the periods of freshets and hold it in reserve for dry weather; and also to lay a new 18-inch cast-iron main from the present reservoir to the city's distribution system to meet the demands of increasing

consumption and also to increase the pressure for fire protection. Such an addition would provide an abundance of water for the city for many years to come and furnish a protection against a possible break in the present main. The income from the plant under the present rate of consumption will in a reasonable time pay the present bonded indebtedness and the cost of the proposed improvement. There is every reason to believe, however, that with the growth of the city, the consumption of water will increase and that there will be a relative increase in the net earnings of the plant.

The estimated total cost of these improvements is \$100,000. It is clear from the above facts that such improvements will add no addition to the city's tax levy. Even if it should a city with 14,000 people and an assessed valuation of five and a half millions dollars could not afford to hesitate in perfecting and improving its water supply under the conditions, which the proof and an inspection of the present plant shows existed in this city.

In purchasing so large a tract of land to surround the proposed reservoir, the Board of Public Works of the city of Hornell has certainly put itself in line with the progressive and scientific improvement and care of municipal water plants and municipal watersheds. The soil of the farm proposed to be purchased is so well adapted for the growing of pine trees that the plan of the authorities to follow up their work of building a new reservoir and laying a new main to the city by reforesting this farm which will surround the reservoir, will not only add to the sanitary condition of their watershed, but will provide a forest growth which will in a few years be another source of profit to the city.

The value of an abundance of pure water to the health and prosperity of the city is so evident, that the Commission cannot do less than commend the Board of Public Works of Hornell in taking early action to increase and improve the city's water supply.

The plans for such increase and improvements have been examined by our engineer who finds them in all respects complete and satisfactory.

The proof shows that taking water from this new source and making the improvements and the additions set forth in the application will not in any manner affect any other municipality or civil division of the State or the inhabitants thereof, particular consideration being given to the present and future necessities for sources of water supply.

The city proposes to issue bonds to the amount of \$100,000 and with the proceeds received from the sale thereof to pay for the purchase price of the land to be taken, build the proposed reservoir and to pay any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans, or from the acquiring of said lands.

In view of all of the conditions shown by the proof upon the hearing to exist in the city of Hornell, and after an inspection of the present water plant and proposed improvements and an examination of the plans and specifications therefor, the Commission is of the opinion that the application of the city of Hornell is to be justified by public necessity and should receive its approval.

The Commission, therefore, finds and determines:

First. That the plans proposed by the applicant are justified by public necessity.

SECOND. That such plans are just and equitable to other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

THIRD. That such plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans, or the acquiring of said lands.

FOURTH. The Commission does hereby approve the maps and profiles for a new and additional source of water supply for the city of Hornell, and for the improvement and enlargement of its present plant, which maps and profiles were filed with the application in these proceedings.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION has caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same, with all the maps, plans, specifications, surveys and other papers relating thereto, filed in its office in the city of Albany, this 24th day of August, 1910.

HENRY H. PERSONS,

MILO M. ACKER, CHARLES DAVIS, ROBERT H. FULLER, JOHN A. SLEICHER, Commissioners.

APPLICATION NO. 84.

SILVER SPRINGS. (Incorporated village.) Town of Gainesville, Wyoming county.

Petition filed August 12, 1910.

Hearings held August 25, September 23 and October 11, 1910.

Village is supplied with water by Castile Water Company from springs, but the supply during the dry season has been insufficient. In 1904 the village installed its own system at a cost of about \$25,000 but upon completion of the work it was found that the supply was inadequate. The springs which appeared to be large and constantly flowing proved to be only surface water which drained into a basin and formed a swamp. The system installed consisted of a circular concrete reservoir, 200 feet above main street, 50 feet in diameter, 12 feet deep, completely covered with a concrete roof and with a capacity of 400,000 gallons. A pipe connects this with the distributing mains, fire hydrants, etc.

The petition asked for approval of plan to sink deep wells, erect a pumping plant and pump directly into distribution mains and from there to reservoir. A pressure of 85 pounds for fire protection. The wells will be sunk to a depth of from 150 to 170 feet.

Water is clear and abundant, but rather hard. Total cost of proposed project, \$14.000. Population estimated at 1,000. The Commission approved the application November 3, 1910. Decision filed November 5, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter ωf

The Application of the VILLAGE OF SILVER | Decision. SPRINGS for a new and additional source of water supply.

Silver Springs, a village with a population of nearly 1,000 people, situate in Wyoming county, comes to this Commission and asks it to approve of maps, plans and profiles for a new and additional source of water supply.

At the present time the village of Silver Springs is supplied with water by the Castile Water Company. This water company takes its water supply from a spring situate at an elevation of 1,585.75 feet, on the lands of the Buffalo, Rochester and Pittsburg Railroad Company, about one mile distant from the business portion of said village and from a spring situate at an elevation of 1,550.4 feet, on lands owned by the water company, near the line of said railroad company and about three-fourths of a mile from the business center of said village.

The water from both of these springs is collected and turned by gravity into a collecting tank located on land owned by the water company, at an elevation of 1.532.20 feet, and from there conveyed through wooden pipes, by gravity, to a wooden tank with a capacity of 65,000 gallons, situate at an elevation of 1,508.7 feet, about one-half mile distant from the business center of the village. The elevation of the Erie station, near the business center of the village, is 1,395 feet. The difference between the elevation of the distribution tank of the water company and the elevation of the business center of the village is about 113.70 feet, which, under normal conditions, will give a water pressure at the Erie station or business portion of the village of 48 pounds per square inch, or thereabouts. This pressure, under normal conditions, with 300 feet of standard hose with a 11/4-inch nozzle will throw a stream of water to the height of 42 feet. Such a pressure is sufficient to furnish ample fire protection to that part of the village of Silver Springs which does not lie at a greater elevation than the Erie station if the supply from the water company's source is large enough to furnish the necessary water. Three ordinary hose of standard make with 11/4-inch nozzle, under a pressure of 47 pounds, will throw 440 gallons of water per minute. The distribution tank of the water company, with a capacity of only 65.000 gallons, with an inflow of 70 gallons per minute from the two springs, would supply water for fire protection for two and one-fourth hours, assuming that the tank is full at the time the three fire streams are turned on. It is very clear that such a supply could not be considered

sufficient for fire protection for that portion of the village which lies at an elevation considerably above the Erie station.

A few years ago, and before the creation of the State Water Supply Commission, the village of Silver Springs laid out and constructed a new municipal plant at an expense of approximately \$25,000. The source of this supply was from what the people thought were large and constantly flowing springs, coming to the surface over a large area. The water was piped into a concrete reservoir with a capacity of 400,000 gallons, situate at an elevation of 1,571.74 feet, and from there distributed throughout the village in pipes belonging to it. These springs, which gave superficial evidence of furnishing such an abundance of water, turned out to be only the surface water which drained into a basin and formed a swamp because there was no sufficient outlet. As soon as the swamp or surface water was drained off, the village was without water. Confronted with such a condition, the village authorities began negotiations with the Castile Water Company to supply them with water. These negotiations resulted in a contract by which the village has been supplied with water by said company. The conditions existing under this water agreement have not been at all satisfactory to water consumers. The supply during the dry season of dry years has been so low that it was impossible for many users to obtain water for domestic purposes during portions of the day. The pressure for fire protection during such time has been entirely inadequate. Such a condition makes it the plain duty of those in authority to provide a sufficient and constant supply of water for both domestic consumption and fire protection to this village.

The village comes to us with a plan which contemplates sinking deep wells and erecting a pumping station and pumping the water from these wells into the present distribution system of the village. The concrete reservoir, situate at an elevation of 1,571.74 with a capacity of 400,000 gallons, connected as it is with pipes throughout the village, is adequate for the needs of the village, providing water can be turned into it in sufficient quantity. There are deep wells which are furnishing an almost inexhaustible amount of water, so far as the needs of this village are concerned, situate in the locality near where the village proposes to sink new ones. With these deep wells and a pumping station the village authorities say that they will have an adequate supply of pure and wholesome water for all municipal purposes.

The village taxpayers, in the manner provided by statute, have voted to install the well and pumping system prayed for in the petition of the village officers.

Were it not for the objections of the Castile Water Company the work of the Commission in this matter would be comparatively simple. This company comes before us and says that they have been to a large expense and also surrendered valuable rights which they had for furnishing water to customers in Castile in order to bring to this village water when it was in need and that they ought not now to be ruined indirectly by the village establishing a new municipal plant which will result in driving them out of business entirely. There is much force to the position of the objectors aside from the fact that care should always be taken not to destroy property.

Taking the water from deep wells, as proposed, cannot interfere with any other municipality, and the plans of the village make adequate provision for the payment of any and all damages, either direct or indirect, that may be caused by installing this proposed municipal system.

The State Water Supply Commission, therefore, finds and determines:

FIRST: That the plans of the applicant for a new source of municipal water supply are justified by public necessity.

SECOND: That the plans of the applicant for a new municipal source of water supply are just and equitable to other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

THIRD: That said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans, or the acquiring of said lands.

The Commission, therefore, approves of the plans of the applicant for a new source of water supply.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same, with all maps, plans, surveys and other papers relating thereto, filed in its office in the city of Albany, this 3d day of November, 1910.

HENRY H. PERSONS,

President.

JOHN A. SLEICHER, MILO M. ACKER, CHARLES DAVIS,

ROBERT H. FULLER, Commissioners.

APPLICATION NO. 85.

ITHACA. (Incorporated city.) Town of Ithaca, Tompkins county.

Petition filed August 22, 1910.

Hearing held September 20, 1910.

City has a water works system and takes water from Six Mile creek. Three reservoirs each with a capacity of 2,000,000 gallons; a steam pumping plant with water power part of year and a mechanical filtration plant comprise the system. The water is collected in a basin on the creek behind a masonry dam and pumped from there into reservoirs. Storage capacity is too small for safety.

The petition asked for approval of plan to build another reservoir 5,000 feet up stream from present dam, across channel of the creek. A new intake will be constructed above new dam at an elevation high enough to deliver water to filtration plant by gravity instead of by pumping. Capacity of reservoir will be 375,000,000gallons and will cover 74 acres. New dam will be

about 100 feet long and 70 feet high, built of concrete. A conduit 24 inches in diameter will be laid from new dam to filter plant, a distance of 9,500 feet.

Population, 16,000, with a student population of 4,000.

35 acres of land to be acquired.

Analyses showed the water to be very good.

Total estimated cost of project, \$150,000.

The Commission approved the application October 7, 1910.

Decision filed October 13, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter of
The Application of the CITY OF ITHACA.

The city of Ithaca by its petition filed with this Commission August 22, 1910, prays for an order approving its maps, profiles and plans as presented for a proposed additional storage, and elevating of the intake for its water supply. The present water supply of the city is obtained from Six Mile creek, the intake being about a mile south of the city limits. The water is pumped from the intake and reservoir dam which contains about ten million cubic feet with a lift varying from forty to fifty feet to the filtration plant. The pumping of the water is done by steam. From the filtration plant the water is distributed to the major portion of the city by gravity. To the higher levels of the city the water is raised by pumping - by water power part of the year when there is a sufficient surplus of water in Six Mile creek - but usually during the summer months and part of the winter months by steam to two high-level systems. There is a third system, a comparatively small amount of water being obtained from artesian wells and pumped by steam to a pressure zone in the western part of the city. There are now five pressure zones. The first and largest, known as the South Hill system, distributes water to the flat or major portion of the city by gravity, at practically sixty pounds pressure. The second zone takes its supply from the clear water basin at the filtration plant that supplies the lower part of the South Hill section of the city and at times is used as a means of raising the pressure for fire on the flats; pressure from this system is about eighty pounds to the square inch. The third zone is from the artesian wells, the pressure at the pumping station being about 120 pounds. The fourth and fifth zones are on East Hill, both being supplied by the same set of pumps at the Vandalia pumping station. The water is raised to the same pressure in both, but for the lower of these two zones, or what is known as the middle-pressure zone it is reduced so as to admit it to the East Hill steel tank, from which it is distributed by gravity. On the higher of these zones the water is under direct pressure from the pumps, the highpressure zones furnishing supply to that part of the city in the vicinity of Cornell University. It is evident that it is practically impossible to supply all portions of the city of Ithaca with water under uniform pressure by reason of its location and the varying elevations within the city limits, but

from a study of the situation and from the testimony produced upon the public hearing, held September 20th last, it is clearly evident that more than three pressure zones are unnecessary. The present water supply and distribution system was installed by the Ithaca Water Works Company and taken over by the city under condemnation proceedings about six years ago. A witness described the plant as "Old and pretty well worn out."

The permanent population of the city of Ithaca is now over 16,000. This number is increased from 4,000 to 5,000 by the student population at Cornell University for nine or ten months in the year. The total demand upon the system is estimated at about 1,600,000 gallons per day, only a small part being metered and very little used for power purposes, and while the quantity of the supply is apparently sufficient and the quality acceptable, yet this result is obtained at great expense. As the system stands to-day it has cost the city approximately \$943,000. The cost of maintenance and operation for 1909 was \$31,186, and the interest charges for the same period \$44,476, a total of \$75,962. The revenue was \$65,000, which included \$9,000 paid by the city to the water department for hydrant service, so that the plant was operated at a loss of about \$20,000. That this condition of affairs is of great public concern to the city of Ithaca is apparent, and the Board of Public Works is justified from the mere statement of the facts in making the exhaustive investigations which have been made by them under the direction of competent engineers to remedy this loss and to improve the system. Investigations and studies have been made of the su: rounding country for possible sources of available water supply for the city. Cayuga lake, artesian wells, various creeks flowing into Cayuga lake, Tanghonock creek, Infield creek, Cayuta lake, Spencer lake, Dryden lake and Far creek, have all been thoroughly examined, and after consideration of each of these available sources of supply, the cost of installation and with due regard for the present indebtedness of the city for its water system, the Board of Public Works now proposes to build a masonry or concrete dam about 55 feet in height with a spillway length of about 100 feet across the channel of Six Mile creek about 5,000 feet upstream from the present dam. It also proposes to construct a new intake above the new dam at an elevation high enough to deliver the water to the filtration plant by gravity instead of by pumping as is now done; to impound some additional water in the new reservoir; to furnish power for pumping to the higher levels in the city; to construct from the proposed dam to the present filtration plant a 24-inch cast-iron pipe line of about 9,000 feet in length and to purchase rights of way and about 35 acres of land for the reservoir site. The storage capacity of the new reservoir will be 375,000,000 gallons, of which about 30,000,000 gallons can never be drawn off, as it will be held below the level of the intake. This gives a net storage of 336,000,000 gallons when allowance is made for evaporation and possible leakage. The plans of this work are well designed and are acceptable. The preliminary estimated cost of the entire work is placed at about \$150,000. The testimony taken on the hearing shows that the expense of operation of the plant will be largely cut down by substituting the force of gravity in delivering the raw water to the filters instead of lifting it by burning coal and in furnishing water power to lift the water to the higher levels of the distribution system; that with the new system established there will be furnished greater opportunity for

increasing facilities for fighting fires, that more water and more power will be had for the uses of the city, and that there will be a saving in expense in operation over and above the additional interest charges caused by the construction of the new system, and that this saving will increase as the demand for the water increases. For these reasons it is clear to this Commission that the plans of the city of Ithaca are justified by public necessity.

The plans proposed do not affect other municipalities and civil divisions of the State, nor the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

The Six Mile creek, from which the present and proposed source of supply is taken, has its sources in various hills to the southeast of the city of Ithaca and also springs in the basin of the valley in the vicinity of Slaterville. It head waters are in the town of Dryden, in the county of Tompkins, from thence it flows northwesterly and empties into Cayuga inlet, having a total length of from 14 to 15 miles; its waters are not now used for any purpose, except by the city of Ithaca. Below the city and down to the outlet in Cayuga inlet there are no villages and no use of its waters is made for any purpose, and there are no instances where the construction of the proposed work, or the acquisition of the proposed lands, or the diversion of the water from Six Mile creek will, directly or indirectly, damage any person below the present intake, the Ithaca Water Works Company having made compensation for rights below the present intake and the city having acquired such rights from that company.

The State Water Supply Commission, therefore, finds and determines:

FIEST: That the plans of the applicant are justified by public necessity. SECOND: That the plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

THIRD: That said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans, or the acquiring of said lands.

The Commission, therefore, approves of the plans of the applicant.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the Commission and caused its official seal to be affixed hereto, and the same, with all maps, plans, surveys and other papers relating thereto filed in its office in the city of Albany this 7th day of October, 1910.

HENRY H. PERSONS,

President.

MILO M. ACKER, CHARLES DAVIS, JOHN A. SLEICHER, ROBERT H. FULLER,

Commissioners.

APPLICATION NO. 86.

ROSLYN. Water District, Town of North Hempstead, Nassau county.

Petition filed October 19, 1910.

Hearing held October 25, 1910.

The population of the water district has been obtaining a supply of water from individual wells, springs and cisterns.

The petition asked for approval of plan to drill or dig wells and springs on property of Isaac Hicks situated near head of Hempstead harbor. Water is to be pumped to a standpipe with a capacity of 140,000 gallons, the top elevation of which is to be 340 feet above sea level and 250 to 280 feet above main street. Plans indicate a well designed distribution system. Pumps to have a working capacity of 1,152,000 gallons daily.

Two acres of land to be acquired.

Total cost of proposed project, \$108,000.

The Commission approved the application October 25, 1910.

Decision filed same date.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the WATER COMMISSIONERS OF THE ROSLYN WATER DISTRICT, of the town of North Hempstead, county of Nassau, State of New York, for the approval of its maps and plans for a new water supply.

Decision

The petitioners, the Board of Water Commissioners of the Roslyn Water District, created in the town of North Hempstead, county of Nassau, State of New York, on August 30, 1910, by the town board of the town of North Hempstead, upon a petition of a majority of the owners of property within the said district, did upon the 19th day of October, 1910, file with the State Water Supply Commission a petition duly executed and verified by John F. Remsen, Ralph Tubby and Thomas Fagan, the members of said board, said petition praying for approval of the Water Commissioners' plans for a new system of water supply.

The petition and accompanying exhibits having been filed as required by and in accordance with the statute and the prescribed rules and regulations, the Commission caused public notice to be given that a public hearing would be held at the Honorable C. E. Remsen's court room in the village of Roslyn, town of Hempstead, county of Nassau, State of New York, at 10 A.M., Tuesday, October 25, 1910, at which hearing the petitioners and all persons duly filing objections to the application, pursuant to statute, would be permitted to present evidence in substantiation of their respective claims.

At the public hearing, Hon. John F. Remsen, chairman of the Water Commissioners, appeared and gave evidence in favor of granting the application, which evidence was substantiated and supplemented by that of Mr. Walter E. Sexton, engineer for the water district.

The petition and the evidence adduced at the hearing show that there is no adequate system of water supply for domestic purposes and fire protection within the district, and that the plans proposed, approval of which is asked, will provide such an adequate system.

The petition and evidence also show that no other municipal corporation or civil division of the State, or the inhabitants thereof will be affected by the plans of the petitioners, and that no indirect damages will result from the execution of the plans or the acquisition of the lands, and as to the direct damages that may result. a just and equitable plan to determine and provide for the payment of the same has been devised, said plan being to purchase required lands if practicable, and if not to acquire the same by condemnation and due process of law.

The only objections to the granting of the application were (1) with reference to deficiencies in the petition, and (2) to the amount of land to be acquired. Sufficient supplementary data has been filed with the Commission to meet the first objection, and the Commission believes that the amount of land to be acquired, namely, two acres, is a reasonable amount to meet the requirements, and the second objection is, therefore, not sustained.

This Commission, therefore, finds and determines:

FIRST: That the plans proposed by the Roslyn Water District are justified by public necessity.

SECOND: That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

THIRD: That said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans, or the acquiring of said lands.

The Commission does, therefore, approve the plans submitted and grant the application of the petitioner.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the [L. S.] Commission and caused its official seal to be affixed hereto and the same, with all plans, maps and other documents relating thereto, filed in its office in the city of Albany, this 25th day of October, 1910.

HENRY H. PERSONS,

President.

CHARLES DAVIS,

JOHN A. SLEICHER,

State Water Supply Commission, State of New York.

APPLICATION NO. 87.

CHERRY CREEK. (Incorporated village.) Town of Cherry Creek, Chautauqua county.

Petition filed September 5, 1910.

Hearing held September 24, 1910.

Village has no public system of water supply and the people depend upon dug or driven wells. For fire protection there is one hand fire engine which takes water from the stream passing through the village, or from two cisterns.

The petition asked for approval of plan to take water from a stream in the hills, two and one-half miles from village into which the water from a series of springs will be gathered. From a collecting basin on the stream the water will be piped through an 8-inch main to a reservoir 150 feet above business center. It will have a capacity of 200,000 gallons and maintain a constant pressure of about 75 pounds.

The analyses showed the water to be of good quality, but there was a high bacterial count and also the presence of the B. Coli type. To guard against contamination of the water, the plans propose the purchase of ten acres of land around the springs. Proposed supply gauges 40,000 gallons daily to serve a population of over 500. Thirty-six fire hydrants.

Total estimated cost of project, \$30,000.

The Commission approved the application October 7, 1910.

Decision filed October 11, 1910.

STATE OF NEW YORK — STATE WATER SUPPLY COMMISSION.

In the Matter

οf

The Application of the VILLAGE OF CHERRY CREEK | Decision. for approval of its maps, plans and profiles for a new source of water supply and the establishment of a municipal water plant.

Cherry Creek, a village of 500 people, situate in Chautauqua county, by its application signed by Emory Kent, the president of said village, and M. H. Butler and E. G. Hubbard, trustees, acting as its water board, and filed on the 6th day of September, 1910, asks for permission to install a new municipal water plant.

The petition shows:

FIRST: That the village of Cherry Creek was incorporated on the 17th day of June, 1893,

SECOND: That on the 15th day of March, 1910, a majority of the duly qualified electors voted to establish a municipal water plant at an expense not to exceed \$25,000 and to issue the bonds of the village therefor.

THIRD: That the board of village trustees, constituting the water board of said village, did on the 28th day of May, 1910, vote to cause a survey to be made to determine the cost of such a municipal water system and to issue the bonds of the village to obtain the money to pay for the cost of the same

FOURTH: That such survey and estimates showed that it would cost an additional \$5,000 to properly construct said municipal water system.

FIFTH: On the 11th day of August, 1910, said village board voted to call a special election to be held on the 23d day of August, 1910, to vote upon the proposition of raising \$5,000 additional upon the bonds of said village in order to pay for the cost of said municipal water plant.

SIXTH: That on the 23d day of August, 1910, the duly qualified electors of said village, by majority thereof, voted to raise an additional sum of \$5,000 for the purpose of establishing said water plant.

SEVENTH: The petition also shows that there is no water supply in said village, except ordinary driven and dug wells and two tanks which are used for fire protection and that the village is without any adequate fire protection at all.

EIGHTH: The petition is also accompanied by maps and plans for the proposed municipal water plant.

The evidence given on the hearing had on the 24th day of September, 1910, at the office of the village clerk establishes all of the allegations in the petition above mentioned. The testimony further shows that the assessed valuation of the village is about \$210,000, only \$7,750 of such assessed valuation being an assessment of personal property and that the village has no bonded indebtedness whatever. The school district of which Cherry Creek is a part is bonded for something like \$5,700.

At the present time the village depends for fire protection upon a hand fire engine which it connects with water tanks sunk in the ground and with the creek running through the village. The proof shows that this method of fighting fires is wholly inadequate and that it is almost impossible to successfully cope with fire when it breaks out in the village. Nearly all of Main street at different times in the past 15 years has been burned, a greater part of which has been rebuilt from time to time. Nearly all of the buildings in the village, including business places, are of wood. On account of the inadequate fire protection the insurance rates are unusually high in the village. The tax rate in the village is only about 1 per cent. of the assessed valuation. There are in the village the usual number of business places, banks, newspapers, churches and stores, a canning factory and a maufacturing company which manufactures dairy supplies. The village proposes to take its water from a series of springs situate about two and onehalf miles from the village and at an elevation which gives them a sufficient pressure for an adequate fire protection. The plan is to buy the ground surrounding the spring, fence it off and remove from the enclosure, which is to be a strip 100 feet wide and 400 feet long, all deleterious and decaying substances and to protect the springs from any possible pollution whatever and then convey the water direct from the springs in a 6-inch closed pipe to a distribution reservoir with a capacity of 225,000 gallons and at an elevation of 150 feet above the village about 2 miles distant therefrom, and then conduct the water from the reservoir to the village through an 8-inch main and then through a distribution system to all parts of the village and to locate 36 fire hydrants which will protect nearly all of the houses in the village. The reservoir will give approximately 70 pounds water pressure.

The springs are so situated that when the ground surrounding them is properly cleared and a suitable fence to protect them from contamination, there will be no houses within a mile of the springs; when so protected there need be no fear of pollution.

The examination by the Commission of the springs and the territory surrounding them leads the Commission to agree with the testimony of the witnesses as to the purity of the source of springs. The Commission is not unmindful of the fact that the analysis of the water taken from the springs which the applicant proposes to acquire shows that there was found bacteria of the bacilli coli communis type in the samples taken. This is accounted for by the fact that animals, pasturing in the fields where the springs are located, were allowed to communicate with the springs and made the land from which the water was taken a place for feeding, drinking and resting during the hot weather. When all of the decaying substances have been removed from in and about the springs and the water is taken directly from the springs before it runs over any low and swampy ground at all, it will be freed from all contamination. The location of the springs are such that taking water from them for this proposed municipal supply will not in any manner interfere with any other municipality or civil division of the State, taking into consideration their present and future necessities for sources of water supply,

The plan of the village to issue its bonds and with the proceeds thereof to pay all damages that may be caused by establishing this water plant, both direct and indirect, is fair and equitable. The fact that the village is without any adequate water protection and that it is composed largely of wooden buildings and has to pay an exceedingly high rate of insurance, it is clear to the Commission that the plans of the village are justified by public necessity.

The State Water Supply Commission, therefore, finds and determines:

FIRST: That the plans of the applicant for a new source of municipal water supply are justified by public necessity.

SECOND: That the plans of the applicant for a new municipal source of water supply are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

THIRD: That said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans, or the acquiring of said lands.

The Commission, therefore, approves of the plans of the applicant for a new source of water supply.

In witness whereof, The State Water Supply Commission hath caused this determination and approval to be signed by the [L. S.] Commission and caused its official seal to be affixed hereto and the same with all maps, plans, surveys and other papers relating thereto, filed in its office in the city of Albany, this 7th day of October, 1910.

HENRY H. PERSONS,

President.

MILO M. ACKER,

JOHN A. SLEICHER,

CHARLES DAVIS,

ROBERT H. FULLER,

Commissioners.

APPLICATION NO. 88.

Andes. Water Co. (Incorporated.) Town of Andes, Delaware county.

Petition filed September 12, 1910.

Hearing held September 30, 1910.

The Water company has been furnishing water to the village of Andes since 1876 and has taken its supply from a spring gauging 64,000 gallons daily which has given an insufficient supply during the past two summers. The system consists of a masonry reservoir 48 feet square, 8 feet deep inside, of 140,000 gallons capacity, located near the spring and connected with the distributing mains by a six-inch cast iron pipe. There are sufficient fire hydrants to protect all parts of village.

The petition asked for approval of plan to take water from two springs on lands of Ira Worden and D. H. Murray, about 2,500 feet northeast of reservoir. Plans propose surrounding each spring with a basin four feet square and three feet deep and lead water therefrom to reservoir through 3-inch and 4-inch pipes. Springs will furnish an additional supply of 80,000 gallons daily.

Analyses showed the water to be well fitted for drinking and household use. Total estimated cost of project, \$3,500.

Water rates, \$10 a year per family. No meters.

The Commission approved the application October 7, 1910.

Decision filed October 11, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter

The Application of the Andes WATER COMPANY for leave to procure and take an additional source of water supply.

Decision.

The applicant is a private water company organized in 1875, with a capital stock of \$6,000.

It is engaged in furnishing water for domestic use and fire protection to the village of Andes and has been since 1876.

Its plant consists of a concrete reservoir with a capacity of 140,000 gallons, situate at an elevation of 100 feet above the main street in the village of Andes. This reservoir is connected with two springs which furnish about 64,000 gallons of water in each 24 hours. From the reservoir there runs a 6-inch cast iron main conducting the water from the reservoir to the distribution pipes in the village. There is also installed as a part of this water system, a sufficient number of fire hydrants to protect all parts of the village.

The customers of the company are permitted to use water ad libitum. Up to about two years ago, the company's water supply was sufficient for all of the wants of the village. Since that time and during the dry months of the year, both summer and winter, there has been a shortage of water and to such an extent that the supply for fire protection has been inadequate and the village left without water for fire protection for days at a time. Such a condition ought not to exist at all, not even for a day. The dangers of a conflagration in the village of Andes are too great to be without ample fire protection at all times.

The proof given at the hearing shows that the company is financially able to make the additions asked for and the proof also shows that there is a public necessity for an increase in the applicant's water supply.

The proof given upon the hearing clearly shows that if the company is permitted to make such improvements by acquiring additional springs, it will be able to keep its reservoir full of water all of the time, which will give constant fire protection for the whole village even though the company's consumers are permitted to use water at their pleasure. It is a great satisfaction to water consumers to be permitted to use all the water they want and not be limited by meter measurements.

The springs proposed to be taken will furnish an additional supply of about 80,000 gallons of water per each twenty-four hours and are so situate that they cannot be used as a municipal water supply by any other municipality or civil division of the State, consideration being had for their present and future necessities for sources of water supply.

The conditions of the water supply of this company as shown to exist in the village of Andes, makes it clear that the plans of the applicant are justified by public necessity. The Commission is satisfied from the plan of the applicant and from a personal inspection of the conditions upon the ground that the improvement asked for by the Andes Water Company, if made, will afford to the village of Andes an adequate water supply for both domestic purposes and fire protection for a long time. The plan of the company is to issue \$3,500 of additional stock and with the proceeds thereof buy the proposed springs and the right of way to conduct the water, which can be collected therein, to the present reservoir and also to pay any and all damages, both direct and indirect, which will result from the execution of its plans.

The Commission, therefore, finds and determines:

FIRST: That the plans proposed by the Andes Water Company are justified by public necessity.

SECOND: That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

THEE: That said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans, or the acquiring of said lands.

The Commission, therefore, approves of the plans of the applicant for a new and additional source of water supply.

IN WITNESS WHEREOF, The STATE WATER SUPPLY COMMISSION hath caused this determination and approval to be signed by the [L. S.] Commission and caused its official seal to be affixed hereto and the same with all plans, maps, surveys and other papers relating thereto, filed in its office in the city of Albany, this 7th day of October, 1910.

HENRY H. PERSONS,

President.

MILO M. ACKER,

CHARLES DAVIS,

JOHN A. SLEICHER,

ROBERT H. FULLER,

Commissioners.

APPLICATION NO. 89.

ORISKANY FALLS. (Incorporated village.) Town of Augusta, Oneida county.

Petition filed October 11, 1910.

Hearing held October 21, 1910.

Village has no public system, but several residents have water piped into their premises from springs near village. Main supply is from dug wells. For fire protection the village has a hand pumping engine which can be used in the vicinity of Oriskany creek. There are also two standing fire pumps in private mills.

The petition asked for approval of plan to take water from a series of springs gauging from 130,000 to 145,000 gallons daily about two miles south of village and at sufficient elevation to deliver water to all points within village. Plans include the construction of a reservoir near springs by building a concrete dam fifteen to twenty feet in height and ninety feet long which will hold 13,000,000 gallons. Main conduit from reservoir to distributing mains will be 12-inch reducing to 10-inch at village line. A dyke to be constructed on west side to divert surface draining and prevent pollution. Pressure varies from 40 pounds to 70 pounds per square inch in thirty-seven hydrants.

Population, 822.

Water rates proposed are 60 cents 1,000 gallons for first 10,000 gallons, 48 cents 1,000 gallons for second 10,000 gallons, 36 cents for third, 30 cents for fourth and 24 cents for fifth. Meters to be installed on all service taps.

Analyses showed the water to be very good; unusually free from organic contamination; evidence of presence of B. Coli Communis.

Total estimated cost of project, \$30,000.

The Commission approved the application November 3, 1910.

Decision filed November 25, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of the VILLAGE OF ORISKANY FALLS for approval of its plans for developing a new source of water supply.

Decision.

The petition in the aforesaid matter was duly filed with the State Water Supply Commission at its office in the Lyon Block, Albany, N. Y., on the 11th day of October, 1910. Thereafter, the Commission caused due notice to be given that a public hearing would be conducted on Friday, October 21, 1910, at 10 a. m., in the Engine House, in the village of Oriskany Falls, Oneida county, N. Y.

Previous to the date of the hearing objections to the granting of the application were duly filed in the office of the Commission by Thomas Gallagher and Charles Lovejoy.

On the appointed day the Commission did conduct the public hearing, previous to which, two of the Commissioners personally inspected the proposed source of supply. At the public hearing Messrs. Gallagher and Lovejoy appeared in person in substantiation of objections filed by them. It appeared that their objections related to the adjustment of the price to be paid for right of way, and the Commission ruled that the question of the amount to be paid was not within the jurisdiction of the Commission and that the interested objectors would be properly protected under the Code of Civil Procedure.

The village of Oriskany Falls, Oneida county, N. Y., was incorporated March 20, 1888, under due proceedings then had and taken under the then

existing laws and statutes of the State of New York, and said village is now an existing legally constituted municipal corporation.

At a special election held on September 6, 1910, the proposition of issuing bonds in the amount of \$30,000 to carry out the project proposed by the petitioner was submitted to vote; the result being 83 votes in favor — 28 votes opposed and one ballot declared void.

The population according to the last official census returns was 822. The unofficial returns for 1910 census indicate a population of 1,005. The population is gradually increasing. Including bank assessments there is over \$300,000 assessed valuation within the corporation limits, the assessed valuation of real property being \$207,200 and personal property \$58,500. The village has no existing or outstanding indebtedness except for current obligations for which funds are available. The petitioner is, therefore, financially able to carry out the proposed project.

There is no existing public water supply system and the private supplies are inadequate and unsatisfactory for domestic purposes. There is practically no effective fire protection for any of the village except the portions immediately adjacent to the Oriskany creek, which are at present protected by means of fire pumps in the knitting mills. The nearest villages are Madison, two miles away, with a population of about 200 and which is located at a higher elevation than Oriskany Falls; and Waterville, which is four miles away and which has a water system.

The investigations of available sources of supply have indicated that the supply known as the Creamery Springs, is the only one which is available and adequate at a reasonable cost. The flow from these springs, in the early summer of 1910, measured from 133,000 to 145,000 gallons per day.

The village proposes to collect and impound the flow from these springs by means of a concrete dam fourteen feet high, ninety feet long, two feet thick at top and ten feet thick at base. The surface area of the proposed reservoir would be about 3.28 acres and the dam would impound about thirteen million gallons of water. A dike is to be constructed on the west side of the reservoir to divert the surface drainage and prevent pollution from that source. The piping system from the reservoir to the streets is entirely adequate to distribute the full supply in a satisfactory manner and to furnish a pressure varying from forty to seventy pounds per square inch. There are no pipes smaller than six inches in diameter. The plan provides for thirtyseven hydrants not more than 500 feet apart so that no house within the village will be more than 300 feet from a hydrant. The estimated cost of the work is \$26,000 while an expenditure of \$30,000 has been authorized. The plan of the village contemplates the use of meters in order to conserve the supply as much as possible. With this arrangement, the available supply will be sufficient to supply the needs of the village for a number of years.

The State Water Supply Commission, therefore, finds and determines:

FIRST: That the plans of the applicant are justified by public necessity.

SECOND: That said plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

THIRD: That said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both

direct and indirect, which will result from the execution of said plans, or the acquisition of said lands.

The plans of the petitioner are, therefore, approved and the application granted.

In WITNESS WHEREOF, THE STATE WATER SUPPLY COMMISSION has caused this determination and approval to be signed by the Com-

[L. S.] mission and caused its official seal to be affixed hereto and the same with all maps, plans, surveys and other papers relating thereto, filed in its office, in the city of Albany, this 3rd day of November, 1910.

HENRY H. PERSONS,

President.

JOHN A. SLEICHER,

CHARLES DAVIS,

MILO M. ACKER,

ROBERT H. FULLER,

State Water Supply Commission.

APPLICATION NO. 90.

SUMMERVILLE. Water District, Town of Irondequoit, Monroe county.

Petition of Commissioners of water district filed October 20, 1910.

Petition was not properly verified and was returned to petitioner's attorney for proper verification, subsequent to which time notice was given the Commission that the petitioners desired to withdraw their petition.

APPLICATION NO. 91.

JOHN A. DREW. Towns of White Plains and Greenburg, Westchester county.

Petition filed October 28, 1910.

Hearings held November 3, November 15 and December 2, 1910. The petitioner is a private individual seeking to supply the towns of Greenburg and White Plains with a water supply.

The petition asked for approval of plan to drive eight or more artesian wells, with a diameter six inches and a depth of from 85 to 100 feet, covering a territory of five and one-half acres. Amount of proposed supply, 1,000,000 to 3,000,000 gallons daily to serve a population of about 18,000. A pumping plant near the wells, capable of delivering 3,000,000 gallons daily directly into distributing system.

Water is free from pollution; absence of bacteria of B. Coli type. The Commission approved the application December 29, 1910. Decision filed January 10, 1911.

STATE WATER SUPPLY COMMISSION.

In the Matter

of

The Application of JOHN A. DREW for the right to engage in supplying water to the inhabitants of a portion of the Town of Greenburg and the Town of White Plains, Westchester county, N. Y.

Decision.

Application filed October 28, 1910.

Hearing at the Village of White Plains, November 3, November 15 and December 2, 1910.

Decision December 29, 1910.

Messrs. Battle and Marshall (George G. Battle, Esq. of Counsel for the applicant).

John M. Digney, Esq., for the Board of Water Commissioners of the village of White Plains, in support of the application.

Messrs. Barrett & Buckbee (H. R. Barrett, Esq., of Counsel for the Board of Trustees of the village of White Plains) objecting.

The applicant, Mr. John A. Drew of the city of New York, proposes to engage in supplying the inhabitants of a portion of the town of Greenburg and a portion of the town of White Plains with underground water for domestic and municipal purposes, taking his supply from a large, flat area situate in the town of Greenburg, northwest of the village of White Plains in the valley of the Bronx river, about one mile south of the Kensico reservoir of the New York city water supply system. The plans proposed include sinking eight or ten wells, six inches in diameter to the depth of from 85 to 100 feet, in a territory of about five and one-half acres in extent and building a pumping station in the vicinity of the wells, capable of delivering at least 3,000,000 gallons per twenty-four hours. Prior to the filing of this application and on June 24, 1910, the Board of Water Commissioners of the village of White Plains entered into a contract with Mr. Drew by which the latter agreed to furnish into the mains and pipes of the White Plains village system and under sufficient pressure, from one to three million gallons per day of pure and potable water situable for domestic and manufacturing purposes, and the Board of Water Commissioners agree to take this water in quantities of not less than 1,000,000 gallons per day for a period of fifteen years and pay for the same at the rate of \$80.00 per million gallons for the first million gallons, and at the rate of \$75.00 per million gallons for the next two million gallons or fraction thereof. The source of this supply of water was not stated in the contract, but on the hearing was shown to be from the lands and plans described in the application filed after the making of the contract.

The only objections that were filed upon this application were those of the board of trustees of the village of White Plains; they were in substance:

(1) That the territory proposed to be used as a source of water supply is adjacent to the territory now owned and used by the village of White Plains, should be reserved for the village of White Plains for its future use and should not be allowed to be taken by a private company.

- (2) That the board of trustees of the village of White Plains disapprove of the action of the Board of Water Commissioners of the village of White Plains, in making the proposed contract.
- (3) That action of the Board of Water Commissioners in making the contract with Drew is at this time unnecessary for the reason that its own watershed, if properly developed, would furnish sufficient water for some time to come. Considering the first objection and giving to it the widest meaning, that the plans of the applicant are not just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

It appears that the villages of Tarrytown, Irvington, Dobbs Ferry, Hastingson-Hudson and Ardsley, all in the town of Greenburg, have public water supplies and that the remaining portion of the town, having a population of about eight thousand, which is rapidly increasing and which is one of the localities the applicant desires to serve, is without a public supply; that applications for such public service have been made and tentative contracts entered into with various customers who desire to use the water and have the benefit of the fire protection to be furnished by the proposed plans. So far as the proposed plans affect the village of White Plains, it was conclusively shown by the testimony taken at the hearings in this matter that the sources of water supply of the village of White Plains as now developed were grossly inadequate to furnish the quantity of water required for the daily use of its inhabitants: that a water famine was impending and that the Board of Water Commissioners had obtained a temporary and uncertain supply from the New York city system at an expense of \$133.33 per million gallons; \$53.33 per million gallons more than the price agreed upon under the Drew contract.

This Commission believes that it was the first duty of every municipality to own, operate and control its own water supply system, but no application has been made up to the present time, by the municipal authorities of the village of White Plains to obtain the sources of supply discovered by the petitioner, and embraced in his application, and upon the hearing it was sought to be proven by several witnesses in behalf of the objectors that the present sources of supply for the village could be further developed so as to produce an additional, if not sufficient, supply for some time to come. It can hardly be fair and equitable to that portion of the town of Greenburg, which the petitioner desires to supply with water, to say that this application is not justified by its public necessity, and to deny this application holding the sources of the applicant's supply for the possible use of the village of White Plains until it determines whether or not it can elsewhere obtain a sufficient supply.

The consent of the State Water Supply Commission has heretofore been given upon the application of the village of White Plains to obtain an additional supply of water from the upper sources of the Mamaroneck river, nevertheless it is for the village authorities to decide whether or not they will take advantage of the discovery by the applicant of an underground source of supply and utilize this source to make up the deficiency in their present supply in advance of any effort on their part to proceed under the consent already given to develop the Mamaroneck river source.

The second and third objections have no relevancy to the present application. Whether or not the contract made between the applicant and the village authorities was a necessary or legal contract, cannot come before this Commission, upon this application for its determination; neither has it a bearing upon the question of public necessity sufficient to justify this Commission in denying this application. The contract might be unnecessary and beyond the power of the village board to make, yet there might be, as is the fact, public necessity and demand on the part of the various localities affected by the application for a public water service.

Analysis of the water to be supplied shows it to be suitable for all domestic purposes,

The application is therefore approved.

The State Water Supply Commission determines:

- (1) That the plans proposed are justified by public necessity.
- (2) That such plans are just and equitable to the other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to the present and future necessities for sources of water supply.
- (3) That said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property both direct and indirect which will result from the execution of said plans and the acquiring of said lands.

IN WITNESS WHEREOF, The State Water Supply Commission hath caused this determination and approval to be signed by the Commission

[L. 8.] and caused its official seal to be hereto affixed and the same with all plans, maps, surveys, and other papers relating thereto filed in its office in the city of Albany, this 10th day of January, 1911.

HENRY H. PERSONS,

President.

MILO M. ACKER, CHARLES DAVIS, JOHN A. SLEICHER, ROBERT H. FULLER.

APPLICATION NO. 92.

ANGOLA (incorporated village), Town of Evans, Erie County.

Petition filed December 7, 1910.

Hearing held December 16, 1910.

Village has no public system of water supply, the inhabitants depending upon dug wells for water.

The petition asked for approval of plan to sink a well in sandy soil on shore of Lake Erie. Pumping plant at well. A brick station in which two pumps driven by gas engine equipped to use either natural gas or gasoline. Each pump to have a capacity of 350 gallons a minute. Combined capacity 1,000,000 gallons. Water will be filtered through natural sandy beach into brick wall fifteen feet in diameter and twenty feet deep. A ten inch force main to be

laid from pumps to a standpipe near center of village 127 feet above lake level, 20 feet in diameter, 100 feet high with a capacity of 236,000 gallons. Distributing system of 8-inch and 6-inch pipes in all streets and 50 hydrants. Pressure at hydrants will be 56 lbs.

Analyses showed the water to be very excellent potable water.

Total cost of proposed project \$55,000.

Population 900.

The Commission approved the application December 29, 1910.

Decision filed December 29, 1910.

STATE OF NEW YORK - STATE WATER SUPPLY COMMISSION.

In the Matter of the

Application of the Village of Angola for a new and additional source of water supply. Decision.

This application was made to the Commission on the 15th day of December, 1910.

The village of Angola, with a population of 930 people was incorporated in the year 1872 or thereabouts. It is situate nearly two miles east of the shore of Lake Erie in the western part of Erie county.

The tracks of the Lake Shore, a four-track railroad and the tracks of the Buffalo and Lake Eric Traction company run through the center of the village. The Nickel Plate and the Pennsylvania Railroad stations are situate within a few rods of the corporation line of this village.

The principal industries in the village are a bicycle manufacturing plant, a flour mill and a macaroni manufacturing company. The property in the village on an assessment basis of 33\%% is valued at \$370,000. Nearly all of the buildings are of wood, consisting of dwellings surrounded by the usual outbuildings besides stores and other business places.

At the present time, the village depends upon the usual dug or driven well for its potable water supply, and upon small cisterns and two hand pumps for fire protection.

Most of these wells for potable water have been in use many years. A long use of wells conduces to the drainage of cesspools, closets and barn yards into them. Although there was no direct evidence given on the hearing showing that the wells in this village had been contaminated from such sources, it is, nevertheless, true that most old wells situate in a village like this, sooner or later come to be drainage receptacles.

Any system of cisterns and hand pumps is wholly inefficient for fire protection. It is, therefore, clear to the Commission that there is a public necessity for a new water supply for this village.

The plan of the village is to sink a well at a point two miles from the center of Angola village and about 120 feet from the Lake Erie shore. The well will be sixteen feet deep and supplied by water from the lake which will percolate through the fine sands. This percolation removes any deleterious substance that may be in the lake water. The well is to be carefully protected

from pollution and a pumping plant erected with duplicate units, each of which will have a capacity of 350 gallons per minute. The water is to be pumped from this well into a standpipe erected on the high ground in the village twenty feet in diameter, 100 feet high and with a capacity of 236,000 gallons. It will be connected by a ten-inch main with a distribution system extending to all parts of the village, supplying nearly every house and connected with fifty double fire hydrants not over 500 feet apart.

The standpipe when full will furnish, without pumping four fire streams through one and one-quarter inch nozzles for four hours. By pumping, these streams could be furnished almost perpetually.

The plans of the proposed plant appear to the Commission to be both ample and practicable and have the approval of our Consulting Engineer.

In all probability the village can sell to the various railroads running through and near it and to the Connor's poultry plant large quantities of water at a rate which will be profitable to both the village and consumer.

Taking water from Lake Erie removes all question of interfering with the water supply in any other municipality or civil division of the State.

A village election has been held and a bond issue for building the proposed plant voted. From the sale of such a bond issue, the village proposes to buy all necessary lands and pay all damages, both direct and indirect, that may result from building such municipal plant.

The State Water Supply Commission, therefore, finds and determines:

First.— That the plans of the applicant for a new source of water supply are justified by public necessity.

Second .- That the plans of the applicant are just and equitable to other municipalities and civil divisions of the State affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

Third.— That said plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans, or the acquiring of said lands.

The Commission, therefore, approves the plans of the applicant for a new source of water supply.

IN WITNESS WHEREOF, The State Water Supply Commission hath caused this determination and approval to be signed by the Commission

[L. S.] and caused its official seal to be hereto affixed and the same with all plans, maps, surveys, and other papers relating thereto filed in its office in the city of Albany, this 29th day of December, 1910. HENRY H. PERSONS,

President.

JOHN A. SLEICHER, MILO M. ACKER, CHARLES DAVIS, ROBERT H. FULLER, Commissioners.

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APPENDIX B.

LAWS RELATING TO THE COMMISSION.

ABTICLE 2, STATE BOARDS AND COMMISSIONS LAW, RELATING TO MUNICIPAL WATER SUPPLIES AND RIVER IMPROVEMENTS FOR PRESERVATION OF PUBLIC HEALTH AND SAFETY.

CHAPTER 569, LAWS OF 1907, RELATING TO WATER POWER AND STORAGE INVESTIGATIONS.

PREFATORY NOTE.

The general laws establishing the State Water Supply Commission and prescribing its powers and duties relating to municipal water supplies were consolidated by chapter 56 of the Laws of 1909, with the laws prescribing the Commission's powers and duties relating to river improvements for the preservation of the public health and safety. These laws are now embodied in article 2 of chapter 54 of the Consolidated Laws, which chapter constitutes the State Boards and Commissions Law.

Chapter 569 of the Laws of 1907, directed the State Water Supply Commission to devise plans for the progressive development of the water powers of the State under State ownership, control and maintenance for the public use and benefit and for the increase of the public revenue. Because of its preliminary and temporary character, this act was not included in the Consolidated Laws. The act is, however, still in force and is reproduced hereinafter, following article 2 of the State Boards and Commissions Law.

APPENDIX B.

LAWS RELATING TO THE COMMISSION.

STATE BOARDS AND COMMISSIONS LAW.

ARTICLE IL*

State Water Supply Commission.

Section 5. State water supply commission.

- Municipal corporations must submit maps and profiles of new or additional sources of water supply,
- Petition for approval of plans for water supply and proceedings thereupon.
- 8. Powers of commission on investigation of plans for water supply.
- Acquiring of land by aqueduct commissioners of New York city not affected.
- 10. Petition for river improvement.
- 11. Determination upon petition for river improvement.
- 12. Proceedings upon approval of petition for river improvement.
- 12-a. Creation of improvement districts.
- Proceedings after final order approving petition for river improvement.
- Entry upon lands, structures and waters in proceeding for river improvement.
- Compensation of owners upon failure to agree in proceeding for river improvement.
- Warrant for payment of owners upon failure to agree in proceeding for river improvement.
- 17. Bonds for river improvement.
- 18. Proceedings for apportionment of cost of river improvements.
- Proceedings for assessment and collection of cost of river improvements.
- 20. River improvement certificates.
- 21. Operation, maintenance and expenses of river improvements and unlawful opening of gates of dam.
- 22. Construction of provisions relating to river improvements.
- 22-a. Duties and qualifications of collectors and other officers.
- 22-b. Ratification of proceedings for improvements,
- Investigation and report as to state system of water supply and sewerage.
- 24. Annual report by commissioners to legislature.
- State jurisdiction of the improvement of water courses at private expense.
- 20. Refund of expenses in certain cases.

^{*}As amended by chapter 284, Laws of 1909, in effect May 4, 1909; chapter 464, Laws of 1909, in effect May 24, 1909; and chapter 285, Laws of 1910, in effect May 13, 1910.

- § 5. State water supply commission.— The state water supply commission is continued. The commission shall consist of five members appointed by the governor by and with the advice and consent of the senate. One of the members shall be designated as president. Any three of said commissioners shall constitute a quorum for the transaction of business. The commission shall make necessary rules and regulations for the proceedings hereunder. commission shall have an official seal. The term of each member of the commission shall be five years, except that the members of said commission first appointed shall hold office respectively one for one year, one for two years, one for three years, one for four years, and one for five years, and as the term of each commissioner expires or otherwise becomes vacant his successor shall be appointed in the manner hereinbefore provided for the appointment of the original commissioners. The members of the commission shall receive an annual salary of five thousand dollars each and be paid their necessary and reasonable expenses actually incurred in the prosecution of their duties, payable monthly. The commission is hereby authorized and empowered to employ a secretary and such engineers, stenographers, clerks and other subordinates as the duties imposed upon them by this article may require, and to fix and pay the reasonable salaries and expenses of such officers, and of all other subordinates for the purpose of proceedings by them under this article.
- § 6. Municipal corporations must submit maps and profiles of new or additional sources of water supply.— No municipal corporation or other civil division of the state, and no board, commission or other body of or for any such municipal corporation or other civil division of the state shall, nor shall any person or water-works corporation engaged in supplying or proposing to supply the inhabitants of any municipal corporation or other civil division of the state with water, after this chapter takes effect, have any power to acquire, take, or condemn lands for any new or additional sources of water supply, until such person, corporation or civil division, has first submitted the maps and profiles therefor to said commission, as hereinafter provided, and until said commission shall have approved the same, or approved the same with such modifications as it may determine to be necessary as hereafter provided.
- § 7. Petition for approval of plans for water supply and proceedings thereupon.—Any municipal corporation or other civil division of the state, or any person or water-works corporation, may make application by petition in writing, to the said commission for the approval of its maps and profiles of such new or additional source or sources of water supply. Such application shall be accompanied by an exhibit of maps of the lands to be acquired and profiles thereof showing the sites and areas of the proposed reservoir and other works, the profiles of the aqueduct lines and the flow lines of the water when impounded, plans and surveys and abstract of official reports relating to the same showing the need for a particular source or sources of supply and the reasons therefor, and shall be accompanied by a plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of said lands and the execution of said plans. Such petition shall also be accompanied by such proof as to the character and purity of the water supply proposed to be acquired as the state water supply

commission shall require. If such petition is made by a person or waterworks corporation, it shall be accompanied by an undertaking in such amount and with such sureties as the state water supply commission shall determine, that such person or water-works corporation will pay the expenses of the hearing and determination as hereinafter provided. Said commission shall thereupon cause public notice to be given that on a day therein named the commission will meet at its office in the city of Albany, or at such other place as it may particularly specify in said notice, for the purpose of hearing all persons, municipal corporations or other civil divisions of the state that may be affected thereby. Such notice shall be published in such newspapers and for such length of time, not exceeding four weeks, as the commission shall determine. At any time prior to the day specified in such notice any person or municipal corporation or the proper authorities of any civil division of the state may file in the office of the commission at Albany objections to the project proposed by such application. Every object so filed shall particularly specify the ground thereof. Said commission shall, upon the day specified in said notice, or upon such subsequent day or days to which it may adjourn the hearing, proceed to examine the said maps and profiles and to hear the proofs and arguments submitted in support of and in opposition to the proposed project, but no person, municipal corporation or local authorities shall be heard in opposition thereto except on objections filed as authorized by this section. The commission shall determine whether the plans proposed are justified by public necessity and whether such plans are just and equitable to the other municipalities and civil divisions of the state affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply, and whether said plans make fair and equitable provisions for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the execution of said plans or the acquiring of said lands. Said commission shall within ninety days after the final hearing and with all convenient speed either approve such application and plans as presented or with such modifications in the application and plans submitted as it may determine to be necessary to protect the water supply and the interests of the applicant or of the inhabitante of the territory supplied by it with water, or the water supply and interests of any other municipal corporation, or other civil division of the state, or the inhabitants thereof, or the water supply and interests of any other person or waterworks corporation, engaged in supplying water to any other municipal corporation or other civil division of the state or the inhabitants thereof; or to bring into co-operation all municipal corporations, or other civil divisions of the state, which may be affected thereby; or to make just and equitable the submitted plan or scheme to determine and provide for the payment of the proper compensation for any and all damages to persons or property, whether direct or indirect, which will result from the acquiring of said lands and the execution of said plans; or it may reject the application entirely or permit another to be filed in lieu thereof, but it shall, however, make a reasonable effort to meet the needs of the applicant, with due regard to the actual or prospective needs and interests of all other municipal corporations and civil divisions of the state affected thereby and the inhabitants thereof. Whenever the commission shall make a decision on any application submitted to it, it shall state the same in writing and sign the same and cause its official seal to be affixed thereto and file the same, together with all plans, maps, surveys and other papers or records relating thereto in its office. The decision of the commission and its action on any application may be reviewed by certiorari proceedings. The expense of any such hearing and determination by the commission shall be certified by said commission to the person, water-works corporation, municipal corporation or other civil division of the state making such application and shall be paid by said applicant within thirty days thereafter upon the certificate of the commission to the persons entitled thereto.

- § 8. Powers of commission on investigation of plans for water supply.—Said commission shall have power to subpœna and require the attendance in this state of witnesses and the production by them of books and papers pertinent to the investigation and inquiries which it is authorized to make by this article, and to examine them and such public records as it shall require in relation thereto. And for the purposes of the examinations authorized by this article, the commission shall possess all the powers conferred by the legislative law upon a committee of the legislature or by the code of civil procedure upon a board or committee, and may invoke the power of any court of record in the state to compel the attendance and testifying of witnesses and the production by them of books and papers as aforesaid.
- § 9. Acquiring of land by aqueduct commissioners of New York city not affected.—Nothing contained in the preceding sections shall in any way affect the acquiring of lands by the acqueduct commissioners of the city of New York under the provisions of chapter four hundred and ninety of the laws of eighteen hundred and eighty-three as heretofore amended.
- § 10. Petition for river improvement.—Any county, city, town or village located upon any river or water course, or any person or persons possessing riparian rights thereon, may present to the commission a petition duly verified, setting forth the facts showing that the restricted or unrestricted flow thereof is a menace to the public health and safety and that it is necessary to the preservation of the public health and safety to regulate the same, and praying that the flow of water in such river or water course shall be regulated under the following provisions of this article, so far as necessary for that purpose. Such petition may be made on behalf of any county by the board of supervisors thereof, on behalf of any town by the supervisor thereof, on behalf of any city by the mayor or board of aldermen thereof, on behalf of any village by the president or board of trustees thereof.
- § 11. Determination upon petition for river improvement.—Such commission on receipt of any such petition shall forthwith determine whether the regulation of the flow of any such river or water course is of sufficient importance to the public health or safety to warrant the interference of the state under the provisions of this article, and shall certify its determination thereupon. If it shall determine that the relief prayed for should be granted, such commission shall at once make or cause to be made such preliminary surveys and investigations as may be proper to determine the causes of the excessive, restricted or irregular flow in such river or water course, the available means to correct the same for the preservation of the public health and safety, and

if relief therefrom is in the opinion of the commission practicable, to take such other and further action with reference to relieving the same as is hereinafter provided for.

§ 12. Proceedings upon approval of petition for river improvement.—If such commission shall determine that a more beneficial flow of water in such river or water course can be had by construction of dykes, clearing out or changing the channel, the erection of a dam or dams or other public works thereon, or upon any tributary thereof, it shall cause to be made preliminary plans and specifications of such proposed improvements, together with a survey of the lands upon which such improvements are to be located, giving the location thereof, and of all lands to be taken, flowed or damaged thereby, with a description by survey or otherwise, of all rights affected thereby, and estimates of the total cost thereof. The commission shall also cause a map to be made showing all such lands, the number of acres in each separate tract and the names of the owners and occupants thereof so far as the said commission can ascertain the same. The commission or the members thereof may enter upon such lands as the commission shall deem necessary for the purpose of doing such work, either by themselves or by their engineers, agents or servants employed by them for that purpose. The commission shall also prepare a statement or list of the counties, towns, cities, villages and individual properties which in its judgment will be benefited thereby, together with a statement of the proportional share of said total cost which should be borne by the said counties, towns, cities and villages respectively, and by the individual owners of property benefited collectively, expressed in decimals; and in case any part or proportion of the cost of such improvement is not properly assessable upon the counties, towns, cities, villages or individual properties, or any of them, as not in the nature of a local improvement, such part or proportion of the expense shall be deducted from the total cost before apportioning the same upon the counties, towns, cities, villages and individual properties as aforesaid, and shall be certified by the said commission to the legislature as a state charge. Said preliminary maps, plans, specifications, estimates and statments shall thereupon be filed in the office of the county clerk of any county benefited and of each county in which any of the aforesaid towns, cities, villages or individual properties benefited are situated. Upon the completion and filing of such preliminary maps, plans, specifications, estimates and statements, the commission shall give notice of the filing thereof, and of the time and place where said commission will give a hearing to persons interested therein, by advertising for five weeks in two newspapers published in each county where such improvement is proposed to be made, and in the state paper published at Albany, at which time and place any person interested may appear, and make any objection to or suggest any modifications in said plans and specifications, and said commission shall have power to adjourn said hearing from time to time as justice may require. Thereupon said commission shall determine whether such proposed improvement shall be abandoned or proceeded with, and what, if any, modifications should be made in said plans, specifications, estimates and statements. If said commission shall determine that said maps and plans should be modified so as to include territory to be benefited or otherwise, not included in the maps, plans and statements already filed, then they shall cause modified maps, plans, specifications, estimates and statements to

be prepared and filed as hereinbefore provided, for said preliminary maps, plans, specifications, estimates and statements, and shall give notice of their completion and filing and of a hearing thereupon, in the manner hereinbefore prescribed for a hearing upon said preliminary maps, plans, specifications, estimates and statements. If said commission shall finally determine that the proposed improvement be made, it shall thereupon make a final order directing the same to be made, and shall cause to be prepared a final map, detailed plans, specifications and estimates of the total cost thereof. commission shall cause the said final order, map, plans, specifications and estimates, or duplicates thereof, certified by them, to be filed in the office of the county clerk of each county in which lands affected or benefited thereby are located. No such improvement shall be undertaken under this article pursuant to any such final order, or any other proceedings had thereon except as hereinbefore provided, until after the said final order shall have been approved by a subsequent act of the legislature which act shall authorize and direct such improvement to be made. If so approved, the said final order shall become effectual and not otherwise.

§ 12-a. Creation of improvement districts.— At any time after such final order shall have been approved by the legislature the commission shall determine what property included in the statement or list as specified in section twelve of this chapter, other than counties, towns, cities and villages, is to be benefited by such improvement, and it shall thereupon cause to be made a survey and map showing the lands so determined to *benefited and the name of the owner of each separate parcel so far as practicable, the quantity in each parcel and the boundary lines thereof and where a parcel is intersected by a town or county line the quantity in such parcel on each side of the town or county line; and shall give to each parcel a corresponding number on said survey and map; and it shall also cause to be made a brief description or designation sufficient to indentify the same, of all other property included in such statement or list so determined to be benefited, with the name of the owner thereof so far as practicable. When said survey and map and descriptions are completed a copy thereof with a certificate of their adoption duly signed by the commission shall be filed in the office of the clerk of each county in which any lands or property so determined to be benefited are situated or exist; and thereafter the commission shall fix a time and place in such county where the owners of said lands and property and other persons interested therein shall have an opportunity to be heard as to the lands and property to be benefited. Notice of the time and place of such hearing shall be given by the commission by notice published at least once a week for two successive weeks immediately prior to the time of such meeting in at least two newspapers published in such county. After such hearings, which may be adjourned from time to time by the commission or by any member thereof, the commission may make any change in its determination as to the lands and property to be benefited; in case of any such change the commission shall make a supplemental survey and map and descriptions, in like manner as is hereinbefore provided with reference to the original survey and map and descriptions, showing such changes, and file in the clerk's office of each county where the

^{*} So in the original.

lands and properties affected by such changes are situated or exist a copy of such supplemental survey and map and descriptions with a certificate of their adoption duly signed by the commission; and thereupon such original survey and map and descriptions, as modified by such supplemental survey and map and descriptions, if any, shall constitute the final determination of the commission as to the lands and property to be benefited by such improvement. Such final determination may be reviewed in like manner as a review is had of a determination of a board of assessors in making an assessment. Such determination as modified upon such review, if any, shall conclusively fix and establish the lands and properties benefited by eaid improvement, and the same together with the counties, towns, cities and villages included in said statement or list shall constitute an improvement district; and the proportional share of the total cost of such improvement and of the maintenance thereof so apportioned to the state and the counties, towns, cities and villages as provided in section twelve of this chapter shall be a charge upon and be payable by the state and said counties, towns, cities and villages respectively, and the proportional share thereof collectively charged upon the lands and properties within such improvement district as in this act provided shall be a lien upon all the lands and properties within such improvement district and shall be borne by and assessed and levied upon and collected from such lands and properties in the manner hereinafter provided.

§ 13. Proceedings after final order approving petition for river improvement.—When any such final order shall have been made and approved by an act of the legislature as hereinbefore provided, such commission shall advertise two successive weeks in the state paper and in two newspapers published in the county wherein such work is to be performed, and if in more than one county then in each of such counties, and in such other newspaper as shall be deemed of advantage, for bids or proposals for said work to be made in writing for the construction of such dam or dams, dykes or other works according to such plans and specifications. Upon the receipt of the proposals, such commission may enter into a contract or contracts with the lowest responsible bidders for the work to be done, or may reject any or all bids and again advertise for further bids. Before entering into any such contract, a bond with sufficient sureties shall be required, conditioned that the contractor will perform all work within the time prescribed in accordance with the plans and specifications, and will indemnify the state and said commission of and from all liability for damages occasioned or suffered by reason of the negligence or wilful fault of such contractor, his employees or any subcontractor or his employees in doing such work. Partial payments for work actually done may be provided for in the contracts and paid in the manner hereinafter provided to an amount not to exceed ninety per centum of the contract price. The payments due on account of any such contracts or for any necessary expense or work in connection therewith in pursuance of this article shall be paid from the river improvement fund as hereinafter provided for.

§ 14. Entry upon lands, structures and waters in proceeding for river improvement.—The commission may enter upon any land, structures and waters necessary for the purposes of this article so far as the same relates to proceedings for the improvement of rivers and water courses; and it may

determine that the right to temporary or perpetual use and occupancy of the property to be taken for the purpose of such improvement is a sufficient title and interest to be acquired therein. If the owner of any property to be taken for such improvement shall agree with the commission upon the sum to be paid therefor, or for the right to use and occupy the same or for any damages sustained, such sum shall be paid as hereafter provided as part of the necessary expense incurred for the purpose of such improvement.

- § 15. Compensation of owners upon failure to agree in proceeding for river improvement.—If the commission can not agree with the owners upon the compensation and damages to be paid for the property to be so taken and appropriated, the commission shall thereupon serve upon such persons a notice that the lands and property described therein have been appropriated by the state for the purposes of this article, and shall proceed to acquire title thereto under the provisions of title one of chapter twenty-three of the code of civil procedure, known as the condemnation law.
- § 16. Warrant for payment of owners upon failure to agree in proceeding for river improvement.— When proceedings are taken under the condemnation law as provided in the preceding section the commission shall file in the comptroller's office a certified copy of the final order provided for in section thirty-three hundred and seventy-one of the code of civil procedure, and a certified copy of the judgment therein rendered pursuant to section thirtythree hundred and seventy-three of said code, together with a certificate of the attorney-general that no appeal from such final order and judgment has been or will be taken by the state, or if an appeal has been taken, a certified copy of the final judgment of the appellate court affirming in whole or in part said final judgment. The comptroller shall issue to the said commission or such officer thereof, as it shall direct, his warrant for the payment of the amount due upon such final order and judgment with interest from the date of the judgment until the thirtieth day after the entry of such final order and judgment, and the same shall be paid out of the river improvement fund hereinafter provided for. Such warrant shall be payable to and shall be delivered by the commission or its officers to the owner or owners of said judgment according to the terms thereof.
- § 17. Bonds for river improvement.— To pay the cost of such improvement and all the expenses and liabilities lawfully incurred by the commission under this article in connection therewith and the maintenance thereof and the certificates authorized by this article to be issued and the interest thereon the commission is hereby authorized to issue, in the name of and under the seal of said commission, in behalf of such improvement district, bonds in a sum not exceeding the amount of the estimated total cost of said improvement and ten per centum thereof in addition thereto, unless the legislature shall under the provisions of section twelve of this chapter authorize the expenditure of an additional amount in excess of ten per centum of the amount of said estimated cost by a further final order as therein provided, in which case such bonds may be issued for such additional amount. Such bonds, together with interest thereon at a rate not exceeding five per centum. payable semi-annually, shall be payable by their terms by the state, municipality and by assessment and levy of taxes upon the lands and properties in such improvement district according to the proportional share thereof determined as herein provided, and they shall be executed when authorized by the

commission by the president of the commission and attested by the secretary thereof. Such bonds shall be issued in serial form in amounts to be fixed by the commission; they shall by their terms become due and payable as determined by the commission in not exceeding fifty years from the date of issue, and they shall be exempt from all taxation by the state or by any county, town, city, village or other subdivision of the state, and shall be a legal investment for savings banks, trust companies, executors and trustees. Such bonds shall be sold by the comptroller at not less than par and accrued interest, and the proceeds thereof deposited in a national or state bank either at Albany or in one of the counties in which such improvement is made, to be approved by the comptroller and the president of the commission. But before any such deposit is made, the comptroller shall require from the depository a bond as security for the repayment of the same, to be approved by him as to form, condition and sufficiency of sureties, which shall provide for the repayment to the commission upon demand of the moneys so deposited. Moneys received under the provisions of this article shall constitute a fund to be known as the river improvement fund, and the portion thereof applicable to each improvement shall be separately kept by the comptroller, and the same are hereby pledged to the payment of the cost and expenses of such improvement and the maintenance thereof, and the bonds and certificates to be issued as in this article provided, so far as the same are applicable to such improvement, and the comptroller is authorized and directed to pay therefrom the principal and interest of said bonds as the same mature and become payable by the terms thereof, and the principal and interest of any certificates issued in pursuance of section twenty of this chapter, and the costs and expenses of such improvement and the maintenance thereof upon the order of the commission or the authorized officer thereof. In case the proceeds of the sale of bonds exceed the total amount of the cost and expenses of such improvement, including the interest on certificates, such excess shall be applied by the comptroller to the payment of the principal and interest of such bonds and the maintenance of such improvement.

§ 18. Proceedings for apportionment of cost of river improvements.— The commission shall assess upon the lands and properties in such improvement district benefited collectively as determined under the provisions of section twelve of this chapter, the benefit accruing thereto by reason of such improvement in the following manner: It shall determine after an investigation thereof the amount of such benefit received by said lands and properties and shall specify the same in a statement thereof opposite the number of each parcel of land and each designation or description of property corresponding with the number thereof on said survey and map and descriptions of such improvement district with the name of the owner or owners thereof, as the same appear on said map and survey and descriptions; such statement shall be signed by the commission and a copy of so much thereof duly certified by the secretary of the commission shall be filed in the clerk's office of each county as relates to the lands and property included in each county. A copy of such statement shall be served upon the owner or owners of such lands and properties assessed, together with a notice specifying the time and place in the county where the commission shall meet to hear any person interested in or aggrieved by such determination; such service shall be made by delivering the same to each of said owners or to any one of several owners or to the tenant of any such lands or properties or by posting the same upon any such lands or properties; such service shall be made at least fifteen days before such meeting, and said statement and notice shall also be published in at least two newspapers published in the county wherein said meeting is to be held at least two weeks immediately prior thereto. The affidavit of said service and publication shall be evidence thereof. The commission shall meet at the time and place specified in such notice, or at the times and places to which said meeting may be adjourned by the commission or any member thereof, and hear all persons interested in or aggrieved by such determination; after such hearing or hearings the commission may change or modify such determination, in which case it shall specify such change or modification in a statement thereof to be signed and filed by it in like manner as hereinbefore provided with reference to such original determination. Any person aggrieved by such determination as originally made or as so modified may review the same in like manner as a review is had of the determination of a board of assessors in making an assessment. And such determination as so modified and as further modified by any final judgment or order made in proceedings to review the same as herein provided shall be final and conclusive, and the amount of the total cost and expense of such improvement and the maintenance thereof and the bonds and certificates to be issued as in this article provided and the interest thereon, which said several parcels of land and properties are to pay and bear shall be based upon the amount of the benefit accruing to them respectively as specified in and in accordance with said determination as so modified, as hereinafter provided, provided, however, that if any of the properties included in such improvement district and in such determination shall cease to exist, so that no part of the tax to be levied thereon as herein provided can be collected against the same, and due proof thereof shall be made to the commission, the commission may apply to the supreme court for an order to show cause why such property should not be thereafter omitted from the assessment roll of the town or city wherein the same is situated, as herein provided; such order to show cause shall be served upon the owner or owners of all the properties in such improvement district, so far as the same can be ascertained, in such manner as the court shall direct, and in case the court shall upon the return of said order so direct the said property shall be thereafter omitted from the assessment roll of said town or city, with the same force and effect in all respects as if the same had not been included in such improvement district. or in said determination. The commission shall annually transmit to the board of supervisors of each county in such improvement district a statement of the amount required to be paid by the lands and properties in said county included in such improvement district, as specified in the determination of the commission, of bonds issued for such improvement maturing during the then ensuing year together with interest thereon, and of the certificates issued by the commission as herein provided remaining unpaid and interest thereon and of the cost of the maintenance of such improvement for such year, which statement shall be approved by the comptroller, and thereupon said board of supervisors shall cause the same to be levied and collected as hereinafter provided.

§ 19. Proceedings for assessment and collection of cost of river improvements.— For the purpose of raising money to meet the said bonds and certificates and the interest thereon, and to provide for the cost and expenses of such improvement and the maintenance thereof the commission shall annually transmit to the comptroller a statement of the amount of the proportion thereof to be paid by the state during such year, in conformity with the determination of the commission in respect thereto as provided in section twelve of this chapter and such amount shall be by the comptroller paid into the river improvement fund herein mentioned applicable to such improvement out of the moneys of the state appropriated for that purpose; and the commission shall annually transmit to the clerk of the board of supervisors of each county, the clerk of each town, the mayor of each city and the president of each village affected by such improvement a statement of the amount of the proportional share thereof to be paid by such county, town, city or village respectively, as determined by the commission, and such county, town, city or village shall cause the same to be assessed, levied and collected in the same manner as provided by law with reference to general taxes, and paid to the treasurer of the county, who shall forthwith forward the same, less his legal fees therefor, to the comptroller to be by him paid into the river improvement fund applicable to such improvement; and the commission shall annually transmit to the clerk of the board of supervisors of each county included in such improvement district a statement of the amount of the proportional share thereof to be borne by the lands and properties collectively in such improvement district within such county during such year, to be assessed, levied and collected as hereinafter provided. The assessors of each town and city included in such improvement district are hereby required to enter upon a separate page in the annual assessment roll of such town or city before the delivery thereof to the board of supervisors the description by number corresponding with the number thereof on said survey and map and descriptions so filed in the county clerk's office, each parcel of land and each designation or description of property within the county in such improvement district, together with the name of the then owner or owners thereof so far as the same can be ascertained by the assessors, and set opposite such number and description of each separate parcel or property in the column of said roll for the total assessed valuation of property the amount of benefit by reason of such improvement received by such parcel or property as stated and specified in the determination of the commission as modified by the court if so modified, on file in the office of the clerk of the county. And the board of supervisors shall each year at the time the annual tax levy is made, levy upon each separate parcel and property in said county within such improvement district appearing upon the assessment rolls of the towns and cities included therein as herein provided such portion of the amount to be paid by all of the property in said county within such improvement district appearing by the statement of the commission and the comptroller made to said board as in section eighteen of this article provided as the amount so assessed against such parcel or property on said rolls for benefit accruing thereto bears to the aggregate amount so assessed on said rolls against all of said lands and properties, and the said taxes so levied shall be collected in the same manner as general taxes are levied and collected, and shall be a like lien as general taxes until the amount thereof is paid to the general treasurer of the

county, superior in force and effect to all other liens except unpaid general taxes; provided, however, that the collection of such tax shall only be enforced by a sale of the land or property assessed. Such taxes when collected shall be paid to the treasurer of said county who shall forthwith pay the same less his legal fees to the comptroller who shall pay the same into the river improvement fund.

- § 20. River improvement certificates.— To temporarily provide for the expenditures which must be made for such improvement before the proceeds of the sale of the bonds hereinbefore authorized to be issued become available, and to provide for the failure to collect in the manner herein provided in any year the amount required to pay the bonds and interest maturing in that year and the cost of the maintenance for that year of such improvement, the commission is hereby authorized to issue and sell certificates of indebtedness bearing interest at a rate not exceeding six per centum per annum, and the proceeds thereof shall be paid into the river improvement fund applicable to such improvement. A separate issue of certificates may be made for each improvement, the amount thereof to be approved by the comptroller, and not to exceed the aggregate estimated cost of such improvement. Such certificates shall be issued in the name of the commission; signed by the president and attested by the secretary thereof, with the seal of the commission attached, and shall be countersigned by the comptroller and the principal and interest thereof shall be payable upon the requisition of the commission.
- § 21. Operation, maintenance and expenses of river improvements and unlawful opening of gates of dam.— The care, control, operation and maintenance of improvements to rivers and water courses provided for in this article shall devolve upon the commission. The commission shall have power to charge to each such improvement undertaken by it such portion of the expenses incurred as it shall determine ratably and equitably is chargeable thereto and to include the same in the apportionment or assessment of the cost and expenses of such improvement. Any person who shall open or close or cause to be opened or closed a gate or gates in any dam constructed under this article so far as the same relates to such improvements without the consent of the commission, shall be guilty of a misdemeanor.
- § 22. Construction of provisions relating to river improvements.—The provisions of this article, so far as the same relates to improvements to rivers and water courses, or the proceedings had or the work done in accordance therewith, shall not be construed as annulling or affecting any power of eminent domain, right, privilege or franchise heretofore created or conferred by law or acquired thereunder nor to permit the actual construction of any dam upon the lands which now constitute a private park under and pursuant to article four of the forest, fish and game law, or pursuant to law, without the consent of the owner of such lands.
- § 22-a. Duties and qualifications of collectors and other officers.—It shall be the duty of each collector and other official to whom is delegated the performance of any service under the provisions of this chapter to faithfully perform the same, and the collector of each town and the treasurer or collecting officer of each city whose duty it shall be to collect assessments as herein provided shall before entering upon the discharge of his duties execute to the people of the state an undertaking with two or more sureties in the penal sum of twice the amount to be collected by him, and such undertaking

shall be approved and filed in the same manner and with the same force and effect as provided by law with reference to an undertaking for the collection of general taxes, and shall provide that he will well and faithfully perform his duty as collector and will pay over to the treasurer of his county and fully account for all moneys received by him under the provisions of this chapter within the same time as provided by law with reference to general taxes. And such collecting officer shall be entitled to receive the same compensation as fixed by law for the collection of general taxes. And each county treasurer whose duty it shall be to receive any assessments or moneys as herein provided shall, before entering upon the discharge of his duties, execute to the people of the state an undertaking in such amount and with such sureties as shall be required by the comptroller, conditioned that he will forthwith pay over to the comptroller upon the receipt thereof by him and account for all moneys which shall come into his hands under the provisions of this chapter and will well and faithfully perform all the duties required of him thereunder.

- § 22-b. Ratification of proceedings for improvements.—All proceedings heretofore taken under the provisions of this article, chapter seven hundred and thirty-four of the laws of nineteen hundred and four, and the acts amendatory thereof and supplemental thereto are hereby legalized, ratified and confirmed.
- § 23. Investigation and report as to state system of water supply and sewerage.— The commission shall report the present disposition of sewerage of each municipal corporation and other civil division of the state, and, if necessary, of adjoining states, with special reference to said disposition affecting the various municipal corporations and other civil divisions of the state in relation to the water supply of this state. Said commission shall also report the advisability of, the time required for and the expenses incident to, the construction of a state system of water supply and for a state system for the disposition of sewerage, if necessary, for all or any of the municipal corporations and other civil divisions of this state, and make such recommendations connected with the subjects of said investigations herein provided for as said commission shall determine. In said investigation concerning either the water supply or disposition of sewerage, said commission shall, so far as possible, make use of all reports and surveys in regard thereto which have heretofore been made. For the purposes of such investigations as are provided for in this section said commission shall have all the powers and authority conferred by section eight of this chapter.
- § 24. Annual report by commissioners to legislature.— The commission shall annually on or before the first Monday in February in each year submit a written report to the legislature. This report shall contain:
- 1. An exhibit of the personnel of the commission and of all engineers and other persone connected with the commission.
- 2. A financial statement showing fully and clearly the condition of the finances of the commission, the amounts and dates of maturity of all bonds and certificates of indebtedness, the amounts of money received and their sources; the amounts of money paid and the purposes for which the same were paid.
- 3. A statement of the several petitions received by the commission and the action taken thereon.

- 4. A descriptive statement of each work of improvement on which work has been done during the previous year.
- 5. A statement of the conditions of improvements previously completed and the results secured by the work of improvement in each case.

In addition to the details as outlined above, the commission shall report to the legislature such other matters as it shall deem proper.

- § 25. State jurisdiction of the improvement of water courses at private expense .- The board of trustees of any village may present to the state water supply commission a petition requesting such commission to assume jurisdiction of the construction of a proposed improvement to a water course adjacent to or in the vicinity of such village. Such petition chall state the location of such water course, the character of the proposed improvement, the estimated cost thereof, shall set forth the fact that unless such improvement is made such water course is a menace to the public health and safety of the inhabitants of such village, and shall request that the commission assume jurisdiction of the construction of such improvement, as provided by this section. The petition must also state that if the state water supply commission assumes jurisdiction of such improvement the money needed therefor will be deposited to the order of the commission in a national bank to be designated by it. The petition shall be accompanied by a plan for such improvement, together with an estimate of the cost thereof, prepared by a competent engineer. Upon the receipt of such petition, the commission shall forthwith cause an investigation to be made and shall determine whether the proposed improvement is of sufficient importance to the public health or safety to warrant the commission in assuming jurisdiction. If it shall determine in the affirmative, the commission shall cause to be made an estimate of the cost thereof, and upon the deposit of money in an amount equal to such estimated cost, the commission shall cause such improvement to be made substantially in accordance with the plan proposed by the petition. If such improvement involves the acquisition of land or water rights the commission may acquire the same by condemnation, if unable to agree upon a purchase price, and shall pay the expenses of proceedings and the awards therein out of the money deposited to its credit. If the improvement consists of the construction or improvement of a dam, the petition may state the levels at which it is proposed to maintain the water stored by such dam, and if the commission accepts jurisdiction of the construction of such improvement in accordance with this section, it shall cause the water stored by such dam to be maintained at the level specified in such petition.
- § 26. Refund of expenses in certain cases.— If subsequent to the construction of such improvement at private expense as provided by this section, the state shall improve such water course, pursuant to the provisions of this chapter, and the dam or other structure constructed or improved at private expense, as provided by this section, would naturally constitute a part of the plan for the improvement of such water course by the state, the persons by whom the money to make such improvement was contributed may present a claim therefor to the court of claims. Jurisdiction is hereby conferred upon the court of claims to hear such claims, and if the court shall determine that the improvement was paid for by the claimants and would have naturally constituted a part of the improvement of such water course by the state if such improvement had not already been made at private expense, the court

shall award to such claimants the amount of money contributed by them toward such expense, and the amount of such awards shall be payable from the money appropriated for the greater improvement of which such improvement would naturally constitute a part.

CHAPTER 569, LAWS OF 1907.

AN ACT authorizing and directing the state water supply commission to devise plans for the progressive development of the water powers of the state for the public use under state ownership and control, and making an appropriation therefor.

Became a law, July 12, 1907, with the approval of the Governor. Passed, three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. After the passage of this act, the state water supply commission is authorized and directed to devise plans for the progressive development of the water powers of the state under state ownership, control and maintenance for the public use and benefit and for the increase of the public revenue.

- § 2. The commission shall proceed at once to collect information relating to the water powers of the state and shall devise plans for the development of such water powers, as it deems available and may devise plans for the development of such other water powers as shall be brought to its attention by the mayor of any city, the president of any village, a supervisor of any town or the chairman of the board of supervisors of any county, by a petition verified and filed with it, praying for the development of such water powers. Each such petition shall show and set forth the public purposes to be served by the development therein proposed, and the commission may subpown the petitioner or petitioners and such other persons as may be deemed desirable to appear before it and to testify under oath, which oath may be administered by any member of the commission, as to the statements made in the petition and as to other matters relating to the subject thereof.
- § 3. The commission shall present a report to the governor and the legislature on or before the first day of February, in the year nineteen hundred and eight, showing the progress made in its investigation, and shall, if practicable, complete its investigations to such extent as will enable it to devise a comprehensive and practical plan for the general development of the water powers of the state, and shall, if practicable, make the final report of such plan to the governor on the first day of February, in the year nineteen hundred and nine. The governor shall, if practicable, submit the said final report with his own recommendations, if any, relating thereto, to the legislature on or before the twentieth day of March, nineteen hundred and nine. In addition to the number provided by law, two thousand copies of the reports of the commission and the recommendations of the governor shall be printed.
- § 4. If any plan devised by the commission shall include the construction of a dam or dams upon any river or water course, the commission shall ascertain and report as nearly as practicable, the water storage capacity in cubic feet of the reservoir created by each such proposed dam, the recorded rain fall on the watershed above such proposed dam, and the maximum, minimum and average flow of water, per second, in cubic feet during each

month in the year at the point where it is proposed to locate such dam. They shall, as nearly as practicable, estimate the water horse power which would be developed at such proposed dam, the probability of selling such water power, and the probable gross and net revenues from both direct and indirect sources which would be derived from the sale of such power at such proposed dam. It shall also state the relation of such gross and net revenues to the total cost of the construction, annual maintenance and depreciation, including the cost of necessary lands and riparian rights, and cost of acquiring them, and after deducting the annual cost of maintenance and depreciation, the net revenues which would be annually derived therefrom, and the length of time in which such net revenues would pay off the whole cost of construction, lands and riparian rights with the interest thereon. The commission may include such other matters as it shall deem proper, in its report to the legislature.

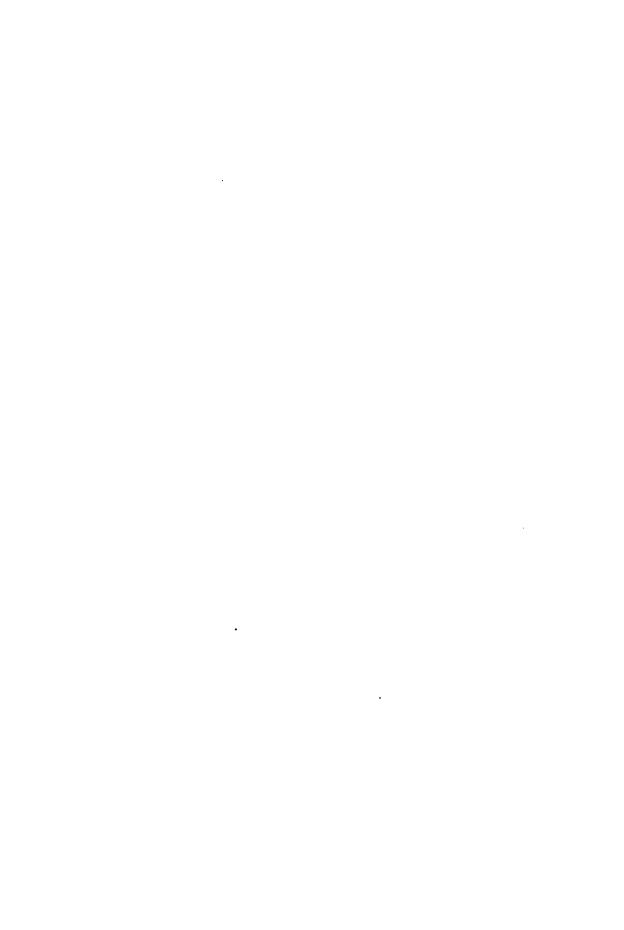
- § 5. The reports of the commission shall specifically designate and recommend what work in their opinion, should be first undertaken and what work should be thereafter undertaken in the order of the importance thereof to the state.
- § 6. In order to determine the probable gross revenues, the rate of charge for the use of the water horse power under contract for sale shall be based upon the aggregate cost of the development, including the land and riparian rights of the single project, the cost of its superintendence, maintenance and depreciation, and the aggregate water horse power available from that single project, and such rate of charge shall be so adjusted that it will produce a net revenue sufficient to pay, in addition to all costs of superintendence, maintenance and depreciation, the interest upon the bonds as the same shall become due and the principal of said bonds at their maturity.
- § 7. Surveys, plans, maps, calculations and estimates of cost may be made to determine the feasibility of any specific project for water-power development.
- § 8. All final surveys, plans, maps, calculations and estimates made pursuant to the provisions of this act shall be made with the same accuracy that would be requisite if the work and project so surveyed had been ordered to be done, and all surveys, plans, maps, calculations and estimates relating thereto shall be preserved for record and reference.
- § 9. The commission in its reports shall treat the general plan it shall devise and recommend for the development of the water power of the state as one state project and shall treat the specific and separate schemes of development as parts of the whole in order that the legislature and the people may have before them at once the most complete and comprehensive statement of the possibilities of the water power of the state and detailed as well as the aggregate cost of the development in such general plan proposed to be made.
- § 10. The commission in its final report shall also include the draft of a bill for a general law providing for carrying its recommendations into effect. It shall give such particular and detailed description of the several separate and specific schemes of development which are parts of the whole as may be necessary to designate clearly the work to be done, and such particulars as to each project shall be stated separately. Such bill shall include a financial plan

providing for the issue of the bonds of the state in such amounts as may be required for paying the cost of the water power development to be made, how and when the bonds shall be issued and sold, the term for which they are to run, the rate of interest thereon, the annual tax to pay and sufficient to pay the interest thereon when due and the principal thereof when the same shall mature. The bill shall provide for the creation of a sinking fund into which the moneys received from the tax by such bill levied shall be paid, and into which the net revenues received from the sale of water power shall be paid, until the moneys in such sinking fund shall be sufficient to fully provide for the payment of the principal of all such bonds and the full interest thereon to the date of their maturity, and the tax shall then be discontinued under the provisions of article seven, section eleven, of the constitution. The bill shall provide for a separate issue of the bonds of the state for each separate scheme of development and for the submission of the bill to a vote of the people for their approval at a general election as provided in article seven, section four, of the constitution for the creation of a debt.

- § 11. The commission shall have power to appoint such engineers, assistant engineers and experts, fitted by experience, to advise the commission and to conduct under its direction the surveys, and the preparation of plans, maps, calculations and estimates as may be necessary within any appropriation which may be available therefor.
- § 12. The general plan which shall be devised by the commission under the provisions of this act, shall not include any of the streams and water courses which supply the canals of the state, excepting such streams and water courses as the state engineer and surveyor and the canal board, shall state in writing, will not, if used as above provided, substantially diminish the water supply of such canals or the navigability thereof, and provided that such plan shall not include any development of water power which would effect a diversion from any of the navigable waters of this state in sufficient quantity to interfere with the navigation of such rivers or water courses.
- § 13. The sum of thirty-five thousand dollars (\$35,000), or so much thereof as may be necessary, is hereby appropriated out of any funds in the treasury of the state, not otherwise appropriated, to carry out the provisions of this act, and the said moneys shall be paid by the treasurer on the warrant of the comptroller to the order of the state water supply commission when certified by that commission to be needed from time to time in carrying out the provisions of this act.
 - § 14. This act shall take effect immediately.



APPENDIX C. RULES AND REGULATIONS GOVERNING WATER SUPPLY APPLICATIONS. [281]



APPENDIX C.

RULES AND REGULATIONS.

Adopted July 13, 1910.

Pursuant to the authority granted and the duties imposed by chapter 55 of the Laws of 1909, entitled "An act in relation to State Boards and Commissions," constituting chapter 54 of the Consolidated Laws and the acts amendatory thereof and supplementary thereto, the following Rules and Regulations have been adopted by the State Water Supply Commission, embodying an outline of the procedure before the Commission and the requirements with reference to applications and plans submitted to it for approval in connection with proposed new or additional public water supplies.

1. Applications.—All persons, water works corporations, municipal corporations or other civil divisions of the State, supplying or proposing to supply water to the inhabitants of any municipality or civil division of the State, and proposing to acquire lands in connection with a new or additional source or sources of water supply, shall make application to the Commission for approval of the engineering and financial plans for such acquisitions and extensions.

Such applications shall be made by verified petition in writing accompanied by exhibits and documents as hereinafter enumerated and shall be addressed to the State Water Supply Commission, Lyon Block, Albany, N. Y.

- 2. Approval of application required.—Before the applicant shall have authority to acquire any lands for a new or additional source of water supply the application must be approved by the Commission.
- 3. Modification of petition.—The Commission may require the petition to be modified both in substance and in form.
- 4. Form of petition.— The petition shall contain a concise statement of all facts from which the Commission may be enabled to determine whether the plans are justified by public necessity; whether they are just and equitable to other municipalties and civil divisions of the State, and whether they make proper provision for the payment of any and all damages, either direct or indirect, to persons or property, and it shall state briefly:
- (a) The legal status of the petitioner, and if the petitioner is a municipality or water district, the date and chapter of the laws organizing the municipality or water district and, if a water company, the date on which and the capital with which the company was incorporated, and a reference to any statute particularly referring to the petitioner.
- (b) The official capacity and the authority of the person or persons verifying the petition.
- (c) The reasons for considering additional water supply at the time of application, whether on account of immediate necessity, or on account of future probable requirements, or both.

- (d) A statement of the principal facts with reference to quality, quantity, water rates and fire protection afforded by the existing water supply system, if any.
- (e) A statement of population affected (1) as of the last official census, (2) as estimated at present.
- (f) A general statement of all available sources of supply, with particular reference to their relative availability and probable cost, sufficiency and suitability, and the reasons for the choice of the particular supply for which application is made.
- (g) A statement of the assets and liabilities of the petitioner, and if a municipality, the total assessed valuation of property as indicated by the last assessment-roll.
- (h) If the petitioner is a water district, a statement of its boundaries, and the total assessed valuation of property in the district.

The petition shall also contain a list of all exhibits accompanying the same, each exhibit being designated by a letter of the alphabet, which shall also be clearly written on the exhibit.

- 5. Exhibits to accompany petition.— The petition shall be accompanied by the following exhibits: (a) a general map of the proposed new system and the existing system, if any, (b) a map of the lands proposed to be acquired or occupied, (c) a section of the United States Geological Survey topographic map showing the territory and watershed affected, (d) profiles of the principal pipe lines, (e) general plans of proposed structures, (f) analyses of water samples, (g) a written report of the petitioner's engineer, (h) an estimate of the cost of establishing the proposed system and of operating expenses, and a statement of the average proposed rate to consumers, (i) a list of those who may be affected by the acquisition of the lands or the execution of the plans of the petitioner; and it shall also be accompanied by (j) a surety bond, if the applicant is a person or water works company and (k) a letter of transmission.
- 6. Dimensions of maps.—All maps, plans, profiles and other drawings submitted in connection with an application shall be on sheets not larger than 27 inches by 40 inches, or shall conveniently fold to these dimensions.
- 7. General map.— The general map shall have indicated thereon the relative position or location of the various lands, structures and works connected with the existing and proposed supply. The maps shall be to a suitable scale and shall show in general the location of lands to be acquired, reservoir and dam sites, pipe lines or aqueducts, pressure or storage tanks, purification works, distributing pipe system and location of valves and hydrants, and the elevations of all controlling points such as at the point of diversion or supply, the crests and depressions in the main pipe lines or aqueducts, and the distributing pipe system and the elevations at each of the principal street intersections in the territory to be served by the proposed supply, and such other material facts as may be of assistance in furnishing an accurate representation of the general features of the proposed system. The map shall have a title endorsed thereon in the lower right hand corner substantially in the following form:

WATER SUPPLY

VILLAGE OF BOLTON, WARREN CO., N. Y.

GENERAL MAP

EXHIBIT A TO ACCOMPANY APPLICATION

BEFORE THE

STATE WATER SUPPLY COMMISSION

July 1, 1910 Scale: 1 in.= 2000 ft.

JOHN SMITH, Engineer

- 8. Land taking map.— The land taking map shall show lands not owned by the applicant proposed to be acquired or occupied, or through which any aqueduct or pipe line is to be constructed, and shall be preferably to a scale of 100 or 200 feet to one inch and shall have indicated thereon the buildings, highways, bridges, streams and the topographic and other important features, including the boundaries of the lands proposed to be acquired and the names of the present owners. If the land indicated is for a reservoir site, the area proposed to be used for storage purposes shall have indicated thereon the surface contours of the ground in sufficient detail to enable the capacity of the proposed reservoir accurately to be determined. The map shall have a title endorsed thereon in the lower right hand corner, substantially as above noted in Rule 7, except that it shall be designated "Land Taking Map."
- 9. Watershed map.—The watershed map shall consist of a sheet or sheets of the United States Geological Survey topographic maps, provided the same are available, showing the watershed or catchment territory affected.* Upon it shall be indicated the line of the divide surrounding the tributary watershed and the location of the territory to be served with water. The map shall have a title endorsed thereon in the lower right hand corner, substantially as above noted in Rule 7, except that it shall be designated "WATERSHED MAP."
- 10. Profiles.— Upon the profiles accompanying each application shall be indicated to suitable horizontal and vertical scales the relative distances and elevations on each of the principal pipe lines or aqueducts, the elevation at each crest or depression in each pipe line and the computed hydraulic gradient shall be clearly shown, and a title shall be endorsed thereon substantially as above noted in Rule 7, except that it shall be designated "PROFILES."
- 11. Structural plans.—Plans for proposed structures need be only in sufficient detail to indicate clearly the design for each of the structures proposed and sufficient information shall be indicated thereon to enable the engineer of

THE DIRECTOR,

U. S. Geological Survey, Washington, D. C.

^{*}The sections of the United States Geological Survey topographic maps may be purchased from the Director of the Survey, at a uniform price of five cents per copy. Each quadrangle covers a section of the state, fifteen minutes in latitude and longitude respectively. A chart showing the sheets available in published form may be obtained by addressing

the Commission to decide upon the suitability of the designs proposed. Each plan shall have a title endorsed thereon substantially as above noted in Rule 7, except that it shall be designated "Plans."

- 12. Analyses of water samples.— The applicant is required to furnish both a bacteriological and chemical analysis of reliable samples of the proposed water supply. To the reports of analyses shall be attached the affidavit of a responsible representative of the petitioner, setting forth the fact that the samples referred to in the report submitted were taken from the proposed source of supply and stating specifically under what conditions the samples were taken and on what date, and any other material facts with reference to such samples.
- 13. Engineer's report.— The report of the engineer who made the recommendations or designs for the proposed system shall be submitted, preferably in full, and shall contain a statement of his opinion with reference to the relative availability and cost of the several available supplies and shall state in full detail the engineering features of the proposed works. The report shall embrace a general description of the proposed system, including the location, elevation, area and capacity required or available for any proposed reservoir or tank, the character and area of the watershed tributary to the point of diversion, the general character and extent and the essential features of the design of controlling, diverting or regulating works proposed, the estimated maximum, minimum and general average static pressures within the territory proposed to be served, the number and distribution of fire hydrants, the location, extent and character of proposed purification or other works, and any other material facts. It is also desirable that detailed information be given with reference to measurements or estimates of rainfall or stream flow, and a detailed estimate of the cost of the engineering construction.
- 14. Estimates of cost and statement of proposed rate.—The estimate of cost accompanying the petition shall state in detail the various items to be included in the total cost of the delivery of water to consumers upon the completion of the work proposed. The statement of the proposed rate should give the average annual rate per 1,000 gallons, proposed to be charged to consumers upon the completion of the work.
- 15. List of persons affected.—The application shall be accompanied by a complete list of the names and addresses of all persons, companies, corporations or civil divisions of the State that, in the opinion of the petitioner, may be affected by the acquisition of lands or water rights required or the execution of the proposed plans.
- 16. Surety bond.—Individuals and water-works corporations making application are required to file with their petition an undertaking for the sum of \$1,000, satisfactory to the Commission with respect to surety, as guarantee for payment of expenses of hearing and determination.
- 17. Letter of transmission.— The application shall be accompanied by a letter of transmission in which the petitioner shall state the most suitable public hall or other place available for conducting the public hearing, the names and addresses and frequency or dates of publication of all local newspapers suitable for publication of the notice of the hearing, the names and addresses of the petitioner and counsel to the petitioner, and the petitioner's engineer.

- 18. Investigation by commission's engineer.—After an examination of the maps, plans and other documents submitted in connection with an application, the Consulting Engineer to the Commission may make an investigation of the proposed source of supply at such time as the Commission may direct and submit his findings in a written report to the Commission.
- 19. Notice of hearing.— Upon the receipt and filing of a petition in proper form and other documents constituting the application, the Commission will, as soon thereafter as practicable, give public notice that on a certain day the Commission will meet at a place specified in said notice for the purpose of hearing all persons, municipal corporations or other civil divisions of the State that may be affected thereby. The notice shall be published by the petitioner in such form, in such newspapers and for such length of time, not exceeding four weeks, as the Commission shall determine.

Proof of publication of said notice shall be filed with the Commission on or before the day specified in said notice for the day of hearing.

- 20. Objections.— At any time prior to the day specified in such notice for the hearing, any person or municipal corporation or the proper authorities of any civil divisions of the State may file in the office of the Commission at Albany objections to the project proposed by the application. Every objection so filed shall be in writing and shall particularly specify the ground thereof, and no person, municipal or other corporation or civil division or their representatives shall be heard in opposition to the project proposed by such application, except on objections so filed. Amendments to the objections may be permitted by the Commission.
- 21. Public hearing.— The Commission will conduct a public hearing upon the day specified in said notice or upon a subsequent day to which the Commission may adjourn the hearing and will hear the proofs and the arguments submitted in support of or in opposition to the proposed project. The Commission may issue subpœnas.
- 22. Evidence.—At hearings the Commission requires that particular attention shall be given by the proofs and arguments to the following questions:
 - (1) Are the plans proposed by the application justified by public necessity?
- (2) Are the plans just and equitable to the other municipal corporations and civil divisions of the State affected thereby and to the inhabitants thereof; particular consideration being given to their present and future necessities for sources of water supply?
- (3) Do the plans make fair and equitable provision for the determination and payment of any and all damages to persons and property, both direct and indirect, which will result from the acquisition of said lands or the execution of said plans?
- 23. Determination by commission.—After the final hearing the Commission will proceed either:
 - (1) To approve such application and plans as presented, or
- (2) To require such modifications in either or both the application and plans as the Commission may determine to be necessary.
 - (3) To reject the application entirely.

The Commission may permit a new application to be filed. The determination of the Commission will be in writing and will be filed together with all plans, maps, exhibits and other papers, records or documents relating to the application. All such records, papers and documents may be examined by any person at the office of the Commission but shall not be removed therefrom except temporarily upon the written order of the Secretary to the Commission after the filing of a receipt therefor in form prescribed by the Commission.

24. Expense of hearing.—The expense of the hearing and determination by the Commission will be certified by the Commission under its official seal to the person, water works corporation, municipal corporation or other civil division of the State making the application and shall be paid by the said applicant within thirty days thereafter, upon the certificate of the Commission, to the persons entitled thereto.

APPENDIX D. DRAFT OF BILL FOR GENERAL WATER STORAGE LAW. [289]



APPENDIX D.

DRAFT OF BILL FOR GENERAL LAW TO PROVIDE FOR CONSERVA-TION OF WATER RESOURCES FOR THE PUBLIC USE AND BENEFIT.

An Acr to amend the state boards and commissions law, to provide for the general and systematic conservation, development and regulation of the water resources within the state for the use and benefit of the people of the state; defining procedure and prescribing penalties; providing for issuing bonds to an amount not exceeding twenty million dollars and for a submission of the same to the people to be voted upon at the general election to be held in the year ninteen hundred and eleven.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Article two of chapter fifty-six of the laws of nineteen hundred and nine, entitled "An act in relation to state boards and commissions, constituting chapter fifty-four of the consolidated laws," is hereby amended by adding thereto a new section, to be section four thereof, and to read as follows:

§ 4. Definitions. The term "real estate," when used in this article, includes all uplands, lands under water, the waters of any lake, pond or stream, all water and riparian rights or privileges, all water powers, water plants, and all dams, races, sluiceways and machinery connected therewith, and any and all easements and incorporeal hereditaments, and every estate, interest and right, legal or equitable, in land or water, including terms for years, and liens, legal or equitable, on real estate, as above defined, by way of judgment, mortgage or otherwise; and all real estate, as above defined, acquired or used for railroad, highway or other public purposes.

The term "storage reservoir," when used in this article, means a basin for impounding water, formed, enlarged or improved by the construction of a dam, and shall be construed to include the dams and dikes or other structures by means of which the water is or is to be impounded; the gatehouses, including controlling gates, sluices, screens, racks and other accessories thereto; spillways, fishways, log or ice chutes or barriers and all accessories thereto; all bridges or roadways over or appurtenant to the dams or dikes; all other structures, devices or appliances connected with or appurtenant to, any of the structures hereinbefore enumerated, in such manner that they cannot be removed without injury to such structures or without impairing the usefulness thereof for the purposes for which they are intended; the lands under the water impounded, or to be impounded by the dam or dams; and such lands surrounding or adjacent to the dam or the water impounded or to be impounded thereby, and such other real estate as shall be necessary for the purposes of the construction, maintenance or operation of a storage reservoir as above defined.

The terms "benefit" or "benefits," when used in this chapter, shall be interpreted to include the services rendered by the state under the provisions of this article to any property or municipality.

The term "water powers," when used in this article, sshall be construed to mean water power developed from falling or flowing water and all electric current and other forms of energy into which such power shall be transformed.

The words "commission" or "commissioners," when used in this article, shall mean the state water supply commission. The term "state engineer," when used in this article, shall mean the state engineer and surveyor. The term "preliminary and supervision expenses," when used in this article, shall be construed to mean expenditures, made or incurred by the state, on account of the services and expenses of its officers and employees in making studies, investigations, surveys, plans, specifications and estimates; in negotiating, drafting and letting contracts; in supervising and directing the construction, maintenance or operation of works and structures, as authorized or required by this article, and the expenses of precuring searches or abstracts of title of real property for the purposes of carrying out the provisions of this article.

- § 2. New sections are hereby added to article two of the state boards and commissions law, to be numbered consecutively, sections thirty-six to sixty-six, both inclusive, to read as follows:
- § 36. Petition and approval when plans have been made and filed. Any person may present a petition to the commission, requesting it to recommend the building by the state of a storage reservoir, specifying the place where such storage reservoir is to be constructed, and stating the purpose or purposes for which its construction is desired. Such petition shall be accompanied with a statement of the facts and estimates showing that such reservoir when built will produce an annual net revenue to the state by the lease of the privilege of using the waters from such storage reservoir, or by the lease of power that can be generated thereby, or by assessments that can be made by reason thereof, and with a guaranty that the petitioner will pay yearly to the state a fixed sum which shall not be less than the amount mentioned in the petition as the annual gross revenue to be derived therefrom, and which sum shall be not less than the amount necessary to provide the annual contribution to the sinking fund for the payment at maturity of the bonds to be issued as herein provided, the interest on said bonds to be paid semi-annually and all charges for maintaining and operating said storage reservoirs. In case maps, plans and specifications for a storage reservoir at or near the location of the proposed storage reservoir are on file in the office of the commission and if it appears therefrom that such proposed storage reservoir will form a unit in the plan for the general and systematic conservation, development and regulation of the water resources within the state, the commission, within thirty days from the receipt of such petition, shall either approve or reject such petition and give its reasons therefor. If the commission shall approve such petition, it shall present a copy of the same with its reasons for approval and with a copy of the maps, plans, specifications and estimates to the governor, who shall within thirty days after the presentation to him of such petition and report, if he approves the same, direct the commission to proceed, in the manner herein provided, to build a storage reservoir at the place named in said petition, and as near as may be according to the maps, plans and specifications on file in the office of said commission.

- § 37. Petition and approval when plans have not been made; procedure. Subdivision 1. Whenever any person shall present a petition to the commission, requesting it to recommend the building, by the state, of a storage reservoir upon any of the rivers, streams, lakes or ponds of the state, which will when completed form a unit in the adopted plan for the general and systematic conservation, development, and regulation of the water resources within the state, and which will in the opinion of the petitioners produce an annual net revenue to the state by the lease of the waters from such storage reservoir, or by the lease of power that can be generated thereby or by assessments which can be made by reason thereof, and maps, plans and specifications for which have not been made and filed by the commission, the commission shall make an investigation of the proposed storage reservoir site, and if it is satisfied that the development requested by such petitioner is feasible and one that will produce a yearly net revenue to the state and if such yearly net revenue shall be secured by proper guaranty by the petitioners, it may proceed to collect necessary information and to make the necessary borings, surveys, maps, plans and specifications for such storage reservoir and file such information, maps, plans and specifications with an estimate of the total cost of such a storage reservoir in its office, which information, maps, plans, specifications and estimates shall be open to public inspection.
- Subd. 2. After such investigation, the commission shall, within thirty days from the filing of such maps, plans and specifications, either approve or reject the petition and give its reasons therefor. If the commission shall approve such petition, it shall present a copy of same, together with its reasons for approval and with copies of the maps, plans and specifications, to the governor who shall, within thirty days after the presentation of such petition to him, if he approves the same, direct the commission to proceed in the manner herein provided to build a storage reservoir at the place named in such petition and as near as may be according to the maps, plans and specifications on file in the office of said commissioners.
- § 38. Commission to co-ordinate plans and prescribe form of petition and guaranty. If more than one petition be presented to the commission requesting it to recommend the building by the state of a storage reservoir, specifying the same or substantially the same place or places where such storage reservoir is to be built, whether plans have been made and filed or not, the commission may approve such petitions in part or reject such petitions in part and give its reasons therefor. If the commission shall approve such petitions in part it may co-ordinate the plans of two or more petitions and present the co-ordinated plans together with its reasons for approval, and with copies of the maps, plans and specifications of the co-ordinated plan to the governor, who shall, within thirty days after the presentation of such maps, plans and specifications to him, if he approve the same direct the commission to proceed in the manner herein provided, to build the storage reservoir at the place named in such plans, and as near as may be according to the maps, plans and specifications filed by the commission. All petitions and guarantees shall comply in manner and form with rules adopted by the commission.
- § 39. Construction without petition. Whenever its investigations show that a storage reservoir can be built upon any of the rivers, streams, lakes or ponds of the state, which when constructed will form a unit in the plan

for the general and systematic conservation, development and regulation of the water resources within the state and when completed and operated will produce a yearly net revenue to the state, the commission may present a request to the governor for authority and direction to build such storage reservoir. Such request to the governor shall be accompanied by an estimate of the total cost of such storage reservoir, copies of maps, plans and specifications, and a report upon the project including an estimate of the nature and amount of benefits that will be conferred upon private property and municipalities situate upon such river or steam below the location of such proposed storage reservoir and the total amount of the yearly gross and net income that the state may expect to receive therefrom. The governor shall, if he approve such request, authorize and direct the commission to proceed in the manner herein provided to build a storage reservoir at the place named in said request and as near as may be according to the maps, plans and specifications on file in the office of said commission.

- § 40. Procedure where canal waters may be affected. Whenever any of plans to be forwarded to the governor for approval affect streams whose waters are used for canal purposes, copies of the maps, plans and other documents shall be first forwarded to the canal board, who shall within one month after the receipt examine and return same to the commission with a report upon the relation of the project to the canal waters and such recommendations, if any, as they shall consider necessary for the protection of the water supplies of the canals of the state. The commission shall then further proceed as hereinbefore specified, and shall include among the documents forwarded to the governor the report and recommendations of the canal board.
- § 41. Modifications of plans, how made. Any change or modification of of any such maps, plans and specifications that will increase the total cost of any such storage reservoir more than fifteen per centum above the estimates of the cost of the project as approved by the governor and on file in the office of the commission, not including land damages, must be approved by the governor.
- § 42. Land maps to be filed. Upon the maps specified in sections thirty-six, thirty-seven, thirty-eight and thirty-nine of this article, there shall be laid out with the names of the owners, and numbered, the various parcels of land that in the opinion of the commission will be required for building, maintaining and operating such storage reservoir, or which in its opinion may be necessary for the prosecution of the work contemplated by this article. The commission shall file in the office of the county clerk of the county wherein the same is situated, a certified copy of the maps, showing the location of such parcels of land.
- § 43. Acquisition of real estate; right of entry. It shall be the duty of the commission and it is hereby authorized to acquire from time to time, and in the manner hereinafter stated, in the name of and for the state, such real estate as the commission may determine to be necessary for any or all of the purposes of this article, and for such object, the commission, its engineers, employees and representatives, may enter upon any real estate for the purpose of making all surveys, measurements and observations, and for obtaining such information and data as the commission may require. The court of claims shall have jurisdiction to hear and determine claims for damages caused by such entry and to render judgment thereon.

- § 44. Real estate that may be acquired. The commission may enter upon and take possession of any real estate, the appropriation of which in its judgment shall be necessary for the purpose of carrying out any or all of the provisions of this article.
- § 45. Real estate; certified descriptions; when state deemed owner. The commission shall make a description of each parcel of the lands referred to on the maps, mentioned in section forty-two of this article, and if possible a description of any other real estate which it shall deem necessary to appropriate and which description shall be certified by the commission to be correct, and it shall indorse upon such certificate a statement that the lands and other real estate, if any, described therein have been appropriated by the state for any of the purposes of this article, and it shall file such description and certificate in the office of the secretary of state. The commission shall thereupon serve on the owner of any real estate so appropriated, a notice of the filing and the time and place of filing of such description and certificate with a description of the real estate belonging to such owner which has been so appropriated. Or the said commission may cause notice of the filing and the time and place of such filing of such description to be served on the owner of any real estate so appropriated by publishing once a week for three successive rceeks in a newspaper published in each county where such real estate is situate a description of the said real estate situate in such county together with a copy of such certificate and with notice of such filing and the time and place of filing such description and certificate; and from the time of such service or the publishing of such notice, the appropriation by the state of the real estate described in such notice shall be deemed complete, and thereupon such property shall be deemed and be the property of the state. Such notice shall be conclusive evidence of an entry and appropriation by the state. The commission shall cause affidarits of such service to be recorded in the books used for recording deeds in the office of the clerk of the county where any of the real estate described therein may be situated, and the record of such notice and of such proof of service shall be evidence of the due service thereof.
- § 46. Acquiring title by agreement with owner. The commission may agree with the owner of any real estate so appropriated, upon the amount of compensation to be paid to such owner and for any damages resulting from such appropriation, or by the relocation or reconstruction of any railroad or highway. If any real estate of any county, town, school district or municipality is required by the state for any of the purposes of this article, the majority of the board of supervisors acting for such county, or the supervisor of any such town acting for such town, or the trustees of any school district acting for such district, or the mayor and common council of any city or president and board of trustees of any village, or other persons, boards or bodies having like power, acting for such municipality may grant or surrender such real estate for such compensation as may be agreed upon between such officers respectively and the commission, and the compensation agreed upon by the commission and such officers shall be paid by the state to the fiscal officer of the municipality or to the person from whom such real estate is purchased or acquired.
- § 47. Presentation of claim to the court of claims. If the commission is unable to agree with the owner for the value of the property so taken or appropriated, or on the amount of damages resulting therefrom, such owner, within one year after the service upon him of the notice of appropriation as

- above specified, may present to the court of claims a claim for the value of such land or other real estate and for such damages, and the court of claims shall have jurisdiction to hear and determine such claim and render judgment thereon. Upon filing in the office of the comptroller a certified copy of the final judgment of the court of claims, and a certificate of the attorney-general that no appeal from such judgment has been or will be taken by the state, or, if an appeal has been taken, a certified copy of the final judgment of the appellate court, affirming in whole or in part the judgment of the court of claims, the comptroller shall issue his warrant for the payment of the amount due the claimant by such judgment, with interest from the date of the judgment until the thirtieth day after the entry of such final judgment, and such amount shall be paid by the treasurer of the state.
- § 48. Acquiring municipal or railroad property; procedure. The commission may agree with any railroad corporation or with any town upon a line of relocation or a plan of reconstruction of any railway or upon a line of relocation or a plan of reconstruction of any highway, and may relocate or reconstruct said railway or highway according to the terms and specifications mentioned in said agreement. If the commission is unable to agree with such company or town upon a line of relocating or a plan of reconstructing such railroad or highway, said commission may relocate or reconstruct said railroad or highway upon such a line and according to such a plan as it may determine to be just and fair to said railroad company or town. Such a corporation or municipality may present to the court of claims a claim for damages, if any, by reason of reconstructing or relocating such railroad or highway and the court of claims shall have jurisdiction to hear and determine such claim and render judgment thereon. Upon filing in the office of the comptroller a certified copy of the final judgment of the court of claims, and a certificate of the attorney-general that no appeal from such judgment has been or will be taken by the state, or, if appeal has been taken, a certified copy of the official judgment of the appellate court affirming, in whole or in part, the judgment of the court of claims, the comptroller shall issue his warrant for the payment of the amount due the claimant by such judgment, with interest from the date of the judgment until the thirtieth day after the entry of such final judgment, and such amount shall be paid by the state treasurer.
- § 49. When costs may be awarded. If an offer is made by the said commission for the value of land appropriated, or for damages caused by such appropriation, or by the relocation or reconstruction of any highway or railroad, and such offer is not accepted, and the recovery in the court of claims exceeds the offer, the claimant is entitled to costs and disbursements as in an action in the supreme court, which shall be allowed and taxed by the court of claims and included in its judgment. If in such a case the recovery in the court of claims does not exceed the offer, costs and disbursements to be taxed shall be awarded in favor of the state against the claimant and deducted from the amount awarded to him, or if no amount is awarded, judgment shall be entered in favor of the state against the claimant for such costs and disbursements.
- § 50. Ascertainment and payment of liens. When a judgment for damages is rendered for the appropriation of any lands or other real estate for any of the purposes specified in this article, and it appears that there is any

lien or incumbrance upon the property so appropriated, the amount of such lien shall be stated in the judgment, and the comptroller may deposit the amount awarded to the claimant in any bank in which moneys belonging to the state may be deposited, to the account of such judgment, to be paid and distributed to the persons entitled to the same as directed by the judgment.

§ 51. Work to be done by contract; advertising; deposit, et cetera. Subdivision 1. Except as hereinafter provided, all work herein specified shall be done and all material and supplies shall be procured under contracts executed in triplicate, and entered into by the commission, on the part of the state, after having been advertised once a week for four successive weeks in two newspapers published in the city of New York, one of which shall be published in the interests of engineering and contracting, and in one newspaper each in the cities of Albany, Rochester, Buffalo and Syracuse and one in each county where the particular piece of work advertised, or some portion of the same is located. The advertisement shall be limited to a brief description of the work proposed to be let, with an announcement, stating where the maps, plans and specifications are on exhibition and the terms and conditions under which bids will be received and the time and place where the same will be opened, and such other matters as may be necessary to carry out the provisions of this article, or the commission may determine are necessary. The proposals received pursuant to such advertisement shall be publicly opened and read at the time and place designated. Every proposal must be accompanied by a money deposit in the form of a draft or certified check upon some solvent state or national bank in the city of Albany or New York, payable at sight to the commission, for at least five per centum of the amount of the proposal. In case the bidder to whom such contract shall be awarded, shall fail or refuse to enter into such contract within the time fixed by the commission, such deposit shall be forfeited to the state, paid to the state treasurer and become a part of the state water storage fund. In case any bid shall be rejected, such deposit shall be returned to the bidder. In cases where the estimated cost of the materials and work does not exceed ten thousand dollars, the period of advertising may be abridged and the work may be advertised by circular letters and posters, when, in the judgment of the commission, such course may be desirable or necessary. The commission may reject any or all bids and readvertise and award the contract in the manner herein provided, whenever in its judgment the interests of the state will be served thereby.

Subd. 2. The contract shall be in a form approved by the attorney-general, and shall be awarded to the person, firm or corporation offering to do such work at the lowest price, and who shall give adequate security for the faithful and complete performance of the contract within the sum specified in such bid, and such security shall be approved as to sufficiency by the commission, and as to form, by the attorney-general, and shall be in an amount equal to at least twenty-five per centum of the sum at which such contract was awarded. If in the judgment of the commission, the work upon any contract is not being performed according to the contract or for the best interests of the state, it shall have power to suspend the work under such contract while it is in progress, and it shall thereupon become its duty to complete the same in such manner as will accord with the contract specifications and be for the best in-

terests of the state, or the contract may be canceled and readvertised and relet in the manner above prescribed, and any excess in the cost of completing the contract beyond the price for which the same was originally awarded shall be charged to and paid by the contractor failing to perform the work. If at any time in the conduct of the work under any contract, it shall become apparent to the commission that any item in the contract will exceed in quantity the engineer's estimate by more than fifteen per centum they shall so certify to the governor and the governor shall thereupon determine whether the work in excess thereof shall be completed by the contractor under the terms and at the prices specified in the contract or whether it shall be done or finished by the commission, or whether a special contract shall be made for such excess in the manner above prescribed. Every contract shall reserve to the commission the right to suspend or cancel any contract as above provided, and to complete the same or readvertise and relet the same as it may determine, and shall also reserve to the commission the right to enter upon and complete any item of the contract which shall exceed in quantity the engineer's estimate by more than fifteen per centum or to make a special contract for such excess as it may determine.

- § 52. Contracts, approval of. All contracts entered into by the commission for the state, pursuant to the provisions of this article, shall be subject to the approval of the governor, and when so approved, shall become binding upon the parties thereto. If any party or parties to any contract made under the provisions of this article have entered into a contract, agreement, combination or conspiracy in the form of a trust or otherwise in restraint of trade or commerce, concerning the use of any water or power provided or regulated or controlled, or in any way furnished directly or indirectly by or by reason of the construction, maintenance or operation of any storage reservoir as provided in this article, the commission shall have the right to cancel at any time any contract made under the provisions of this article. Such right of revocation may be exercised in behalf of the state by the commission and thereupon the commission shall make due assessment of the benefits received or to be received by the property affected which assessment shall be a tax upon said property.
- § 53. Operation of storage reservoirs; powers of commission. The commission is hereby authorized to make rules and regulations for the control, operation and maintenance of storage reservoirs, the flow of the water impounded therein to the properties benefited and such other rules and regulations as shall be necessary to carry into full force and effect the provisions of this article, and to perform any and all acts necessary to the enforcement of such rules and regulations or necessary for the purpose of carrying the provisions of this article into full force and effect.
- § 54. Lease of the use of water and power. For the purpose of providing a revenue for the state the said commission is hereby authorized to lease from time to time by an original lease, or by a renewal or renewals thereof to any person, association or corporation, municipal or otherwise, for terms not exceeding fifty years each, the right to use water from any storage reservoir built by the state, as herein provided, or the power that may be developed thereby. The yearly sum agreed upon to be paid to the state for the use of such water or power shall be not less than the amount specified in section thirty-six hereof, and shall be a tax upon the real estate or other property

benefited, municipal or otherwise, and upon the property used for the development or transmission of such power, and such sum shall be a lien thereon with the same effect as taxes, assessments and levies lawfully made. A copy of the agreement made by the commission for the lease of the right to use such water or power, fixing the sum to be paid yearly by such person or corporation shall be filed by the commission with the local assessors in the assessment district wherein the property benefited, or where the power developed, is situate, and said assessors shall place the amount to be paid yearly on the asssessment-roll opposite the property benefited or used under the head of "property benefited by water storage" and such sum shall be collected in the same manner as general taxes are collected and shall be paid to the treasurer of the county, and by him paid to the state treasurer to the credit of the state water storage fund. If such agreement be made with a mupality fixing the yearly amount to be paid by it for the advantages that may accrue to it by reason of building and operating such storage reservoir, a copy thereof shall be filed with the chief fiscal officer of such municipality. The yearly sum fixed by such agreement shall thereupon become a tax upon such municipality. It shall be the duty of the officers of said municipality to raise yearly such sum of money in the manner in which the general expenses of such municipality are raised and pay the amount thereof yearly to the state treasurer, who shall deposit the same to the credit of the fund to be known as the state water storage fund.

- § 55. Contracts with persons and municipalities as to benefits conferred. For the purpose of providing a further revenue for the state, and in consideration of benefits to be conferred, the commission is authorized to enter into a contract for a reasonable consideration with any person or corporation, municipal or otherwise, whose property is benefited by reason of building and operating a storage reservoir. The sum so agreed upon shall be a tax upon the property and municipalities benefited, to be assessed, levied and collected in the manner provided in section fifty-four of this article.
- § 56. Fixing yearly benefits. For the purpose of providing a further revenue for the state, the commission shall, after the completion of a storage reservoir, and every five years thereafter, assess the value of the yearly benefits conferred by building and operating any such storage reservoir, upon the property and upon the municipalities benefited. The yearly sum so assessed shall be a tax upon each piece of property or municipality so benefited and become a lien upon such property and municipality with the same effect as taxes lawfully assessed and levied. When the assessment is made upon private property, the commission shall file a statement of the amount of such benefits assessed by it as aforesaid with the local assessors in the assessment district wherein the property so benefited is situate, and said assessors shall place the amount to be paid yearly on the assessment-roll opposite the property benefited and under the head of "property benefited by water storage" and such sum shall be collected in the same manner as general taxes are collected, and shall be paid to the treasurer of the county and by him paid annually to the state treasurer to the credit of the state water storage fund. Where the assessment so made is upon a municipality, the commission shall file a statement of the amount so fixed by it with the chief fiscal officer of such municipality. The yearly sum so assessed by the commission against the municipality shall thereupon become a tax upon such municipality, and it

shall be the duty of the officers of such municipality to raise yearly the said sum of money in the manner in which the general expenses of such municipality are raised, and pay the amount thereof yearly to the state treasurer, who shall deposit the same to the credit of the fund known as the state water storage fund, but no tax shall be assessed under this section upon the property where the owner has entered into a contract with the commission to pay yearly to the state the value of the benefits conferred by water storage during the life of such contract nor upon any municipality which has entered into a like contract during the life thereof. But if the contract which the owner has entered into with such commission be for any purpose canceled by said commission, then the commission shall by due assessment assess for the benefits received by said property under the provisions of this article.

- § 57. Report to the commission. Every person, copartnership, association or corporation, municipal or otherwise, subject to taxation for the benefits conferred by reason of the storage and control of the waters of any river, stream, lake or pond of the state as herein provided shall, within thirty days after receiving notice, make a written report to the commission containing a full description of its property, together with any information relating to the value of such benefits as may be required by said commission. The commission may, from time to time, require a further or supplemental report from any such person, copartnership, association or corporation, municipal or otherwise, containing information and data upon such matters as it may specify. Every report required by this section shall have annexed thereto the affidavit of the president, vice-president, secretary or treasurer of the association or corporation or one of the persons, or one of the members of the copartnership making the same or of the chief executive officer if it be a municipality to the effect that the statements contained therein are true. The commission may prepare blanks to be used in making the reports required by this section. Every person, copartnership, association or corporation, municipal or otherwise, failing to make the report required by this section, or failing to make any special report required by the commission within a reasonable time specified by it, shall forfeit to the people of the state the sum of one hundred dollars for every such failure and the additional sum of ten dollars for each day that such failure continues.
- § 58. Hearing on assessment. On making an assessment of the benefits conferred by water storage, control and regulation as herein provided, the commission shall immediately give notice in writing to each person, copartnership, association or corporation, municipal or otherwise, affected, stating in substance that such assessment has been made and the amount thereof, and that the commission will meet at its office in the city of Albany on a day specified in such notice which must not be less than twenty nor more than thirty days from the date of the notice, to hear and determine any complaint concerning such assessment. Such notice must be served at least ten days before the hearing; and it may be screed on a copartnership, association or corporation, by mailing a copy thereof to it at its principal office or place of business; and on a person either personally or by mailing it to him at his place of business or last known place of residence; on a municipal corporation by mailing it to its chief executive officer. Any person, copartnership, association, or corporation, municipal or otherwise, entitled to notice under this section shall have the right to be heard and to file affidavits and other proofs

in respect to the valuation of such benefits. Section thirty-six of chapter sixty of the consolidated laws known as the tax law, applies in so far as practicable to the hearing by the commission under this section.

- § 59. Certiorari to review assessment. An assessment of benefits as aforesaid by the commission may be reviewed in the manner prescribed by article thirteen of chapter sixty of the consolidated laws, known as the tax law, and that article applies as far as applicable to such an assessment, in the same manner and with the same force and effect as if the assessment had been made by local assessors; a petition for a writ of certiorari to review the assessment must be presented within fifteen days after the completion and filing of the assessment-roll and the first posting of publication of notice as required by law. Such writ must run to and be answered by the commission, unless otherwise directed by the court or judge granting the writ. An adjudication made in the proceeding instituted by such writ of certiorari shall be binding upon the local assessors and any ministerial officer who performs any duty in the collection of said assessment in the same manner as though said local assessors or officers had been parties to the proceedings. The commission on filing with the city, town or village clerk, a statement of the valuation of such benefits shall give to the person, copartnership, association or corporation, municipal or otherwise, affected, written notice that such statement has been filed, and such notice may be served on the copartnership, association or corporation, municipal or otherwise, by mailing a copy thereof to it at its principal office or place of business, and on a person, either personally or by mailing it to him at his place of business or last known place of residence.
- § 60. Commission to appear by counsel. In any proceeding for the review of an assessment of benefits as aforesaid made by the commission, said commission is authorized to appear by counsel to be designated by the attorney-general. The compensation of such counsel and the necessary and proper expenses and disbursements, including all expenses of procuring evidence of experts, incurred or made by him in the defense of such proceedings, and upon any appeals therein, shall, when audited and allowed as are other charges against such tax districts, be a charge upon the tax district upon whose roll appears the assessment sought to be reviewed. Where, in one proceeding, there is reviewed the assessment of benefits to more than one tax district, separate accounts shall be rendered of such costs, expenses and disbursements to the proper officers of each of said districts and audited and allowed by them as aforesaid.
- § 61. Tax not to affect other taxes. The imposition of payment of a tax as provided in this article shall not relieve any person, assocation, copartnership or corporation, municipal or otherwise, from the payment of any other tax.
- § 62. State water storage fund. All moneys received under the provisions of this article except moneys received from the sale of bonds, issued pursuant to sections sixty-four and sixty-five hereof, shall be paid into the state treasury to the credit of the fund to be known as the state water storage fund. The sums so paid into the state treasury shall, when appropriations have been made therefor be used:
- 1. For paying the cost of maintaining and operating the storage reservoir from which said money was received.

- 2. For addition to the sinking fund to retire the bonds issued as provided in sections sixty-four and sixty-five at maturity.
- 3. For building other storage reservoirs or in making investigations in anticipation thereof, and
 - 4. For deposit to the general credit of the state.
- § 63. Employees. The commission is authorized to employ such engineers, experts, inspectors or other employees as may in its opinion be required in carrying out the provisions of this article.
- § 64. Bond issue. There shall be issued in the manner and at the time hereinafter specified, bonds of the state in amount not to exceed twenty million dollars, which bonds shall be sold by the state, and the proceeds thereof paid into the state treasury and so much thereof as shall be necessary shall be used for the construction of storage reservoirs, as in this article provided. Such bonds, when issued, shall be exempt from taxation.
- § 65. Bonds, sale of; tax, assessment and collection of. Whenever the governor shall direct the commission to build a storage reservoir as herein provided, he shall file a duplicate copy of such direction with the comptroller, and it shall be the duty of the comptroller to cause to be prepared the bonds of this state to an amount necessary to complete such storage reservoir but in no event to exceed twenty million dollars; such bonds to bear interest at a rate not exceeding four per centum per annum, which interest shall be payable semi-annually in the city of New York, at the office of some bank or trust company to be designated by the comptroller and named therein. Such bonds shall be issued for a term of not more than fifty years from their respective dates of issue, and shall not be sold for less than par. The comptroller is hereby charged with the duty of selling said bonds to the highest bidder after advertising for a period of twenty consecutive days, Sundays excepted, in at least two daily newspapers printed in the city of New York, and one in the city of Albany. Such advertisement shall contain a provision to the effect that the comptroller, in his discretion, may reject any or all bids received in pursuance of such advertisement, and in the event of such rejection, the comptroller is authorized to readvertise for bids, in the manner above provided, as many times as in his judgment may be necessary to effect a satisfactory sale. Not more than two million dollars in amount of such bonds shall be sold during the year following the date on which this chapter takes effect and thereafter such bonds shall be sold in lots not exceeding one million dollars at a time, as the same may be required for the purpose of making partial or final payments on work contracted for in accordance with the provisions of this article, and for other payments lawfully to be made under the provisions hereof. There is hereby imposed for each year after this act takes effect, and until all the bonds issued under the authority of this article shall be due, an annual tax of twelve one-thousandths of a mill upon each dollar of valuation of the real and personal property in this state subject to taxation, for each and every one million dollar or part thereof in par value of such bonds, issued and outstanding in any of said fiscal years, the annual amount of such tax to be computed by the comptroller, which taxes shall be assessed, I-vied and collected by the annual assessment and collection of taxes in each of such years in the manner prescribed by law and shall be paid by the several county treasurers into the treasury of the state, and the proceeds of such tax, after paying the interest due upon the outstanding bonds, shall be

invested by the comptroller, and, together with the interest arising therefrom, shall be devoted to the sinking fund which is hereby created, payment from which shall only be made to the extinguishment of the indebtedness created by the sale of the aforesaid bonds as the said bonds become due and for no other purpose whatever. Whenever the sinking fund herein created becomes equal to the amount of the outstanding bonds, no further direct tax shall be levied on account of said sinking fund, and said tax shall be reduced to an amount equal to the accruing interest.

§ 66. Effect of this article. Nothing in this article contained shall be deemed or construed to grant or confirm to any person or corporation any right or privilege claimed by any person or corporation, nor shall it be deemed or construed to impair or lessen any right or power now belonging to the people of the state.

No private property or right, perpetual or limited, shall be deemed or construed as extended or confirmed by the provisions of this article. Whenever real estate has been, now is, or hereafter shall be used for any private purpose under any franchise, grant, lease or license from or under authority of this state, expressed or implied, which may be revocable by the state or under its authority, or whenever such real estate now is or hereafter shall be used by the sufferance of the state, the commission shall have the right for and in behalf of the state to cancel and revoke such franchise, grant, lease, license or any right arising from the sufferance of the state, and when the commission shall cancel the said franchise, grant, lease, license or right arising from the sufferance of the state, the said franchise, grant, lease, license and rights arising from sufferance shall thereupon cease and be of no further force and effect.

- § 3. Sections thirty and thirty-one of article three of the state boards and commissions law are hereby renumbered sections seventy and seventy-one, respectively.
- § 4. Sections forty, forty-one, forty-two and forty-three of article four of the state boards and commissions law are hereby renumbered sections eighty, eighty-one, eighty-two and eighty-three, respectively.
- § 5. Section fifty of article five of the state boards and commissions law is hereby renumbered section ninety.
- § 6. Sections fifty-five and fifty-six of article six of said act are hereby renumbered sections one hundred and one hundred and one.
- § 7. The schedule of section head notes at the beginning of each of said articles two, three, four, five and six of the state boards and commissions law is hereby amended to correspond to the numbering and head notes of the sections in each such articles, respectively.
- § 8. Chapter to be submitted to vote. This act shall take effect when it shall have been submitted to the people at a general election and shall have received a majority of all the votes cast for and against it at such election; and the same shall be submitted to the people of this state at the general election to be held in November, nineteen hundred and eleven. The ballots to be furnished for the use of voters upon the submission of this law shall be in the form prescribed by the election law and the proposition or question to be submitted shall be printed thereon in substantially the following form, namely: "Shall chapter (here insert the number of this chapter) of the laws of nineteen hundred and ten, entitled 'An act to amend the state boards

and commissions law to provide for the general and systematic conservation, development and regulation of the water resources of the state for the use and benefit of the people of the state; defining procedure and prescribing penalties; providing for issuing bonds to an amount not exceeding twenty million dollars and for a submission of the same to the people to be voted upon at the general election to be held in the year nineteen hundred and eleven,' be approved."

APPENDIX E. PROGRESS REPORT ON HYDROGRAPHIC WORK CARRIED ON IN COOPERATION WITH THE UNITED STATES GEOLOGICAL SURVEY. By C. C. Covert, District Engineer, U. S. Geological Survey.

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APPENDIX E.

PROGRESS REPORT ON HYDROGRAPHIC WORK CARRIED ON IN CO-OPERATION WITH THE UNITED STATES GEOLOGICAL SURVEY.

LETTER OF TRANSMISSAL.

DEPARTMENT OF THE INTERIOR,

UNITED STATES GEOLOGICAL SURVEY,

WATER RESOURCES BRANCH.

ALBANY, N. Y., January 23, 1911.

Hon. Henry H. Persons, President, State Water Supply Commission of New York, Albany, N. Y.:

DEAR SIR.—I have the honor to hand you herewith my report on the hydrographic work carried on in co-operation with the Commission during 1910.

I have been assisted in this work by Mr. W. G. Hoyt, Mr. John J. Phelan, Mr. F. J. Shuttleworth, Junior Engineers, U. S. Geological Survey, and Mr. W. A. James, Computor.

Special acknowledgment is made of the very efficient manner in which your consulting engineer, Mr. Walter McCulloh, has represented the Commission and the assistance rendered by your secretary and members of the engineering force.

Acknowledgments are due the officials of the State Engineer's department for assistance in the maintenance of stations on the Raquette, Oswegatchie, and other streams and the use of other data collected.

Acknowledgments are also due to the officers of the United States Weather Bureau for climatoligical data, also to the power companies and individuals who have furnished data herein contained.

Very truly yours,

C. C. COVERT,

District Engineer.

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PROGRESS REPORT ON THE CO-OPERATIVE HYDROGRAPHIC WORK.

INTRODUCTION.

Perhaps no work carried on by the Water Supply Commission has any greater bearing on the future development of the State and the final solution of the storage problems considered in the Commission's report than has the accumulation of stream flow data which was begun by the State under an Act which became a law April 13, 1900. This Act provided \$1,000 for cooperation of the State Engineer with the U. S. Geological Survey for the purpose of "the measurements of volume of streams and flow of water in the State of New York." Subsequent Legislatures have increased the amount to \$1,500 per year, which sum has been equaled or exceeded each year by the survey with the exception of 1906, when the reduced Federal appropriations forbade any allotment for New York, and resulted in the transfer of the district office from Utica, N. Y., to Boston, Mass.

Co-operation with the State Engineer was renewed in 1907, and the Fuller law enacted that year made it necessary for the Water Supply Commission to obtain additional stream flow data. A co-operative agreement with the director of the U. S. Geological Survey was arranged which resulted in the establishment of a number of new stations.

Prior to March 1, 1909, it was impossible for the Federal Government to make any allotment for co-operative work with the Commission and the chief advantages of the co-operative agreement, to the State, were the services of an organization already trained in the collection of stream flow data and records that would be comparable with those obtained in other parts of the United States.

March 1, 1909, the U. S. Geological Survey re-established a New York district office at Albany, transferred from Boston all the original data in connection with the New York work and made such other preparations as were possible to improve this branch of the co-operative service.

The following appropriations have been made for the work since that date:

June 1, 1909, Water Supply Commission	\$3,500
July 1, 1909, U. S. Geological Survey	1,000
July 1, 1910, Water Supply Commission	10,000
July 1, 1910, U. S. Geological Survey	1,000

The appropriation of \$10,000 July 1, 1910, by the Water Supply Commission was for the following purposes:

Stream gaging	\$7,500
Rain fall records	1,500
Evaporation	1,000

The appropriation of \$1,000 by the survey does not include all the funds diverted to New York. There is an additional allotment of \$1,500 for cooperation with the State Engineer and Surveyor, as before mentioned, for the purpose of maintaining gaging stations which have been in existence for a number of years. August 1st the New England work, outside of the State of Maine, was placed under the direction of the Albany office so that now considerable data pertaining to New York and New England are on file in Albany and it is hoped that State interests will continue to the extent that the office may be continued and the efficiency of the work increased.

The larger appropriation in 1910 made it possible to materially improve the work. The scope of the stream gaging work has gradually increased from six stations in the Hudson river drainage in 1907 to twenty stations in 1910 distributed among the most important drainage basins of the State. Seven new stations were established this year. Cableway equipment is on the ground for four stations and has been erected at two. Concrete wells and shelters have been built for two recording gages and three such gages are in place—one on Sacandaga river at Hadley, one on Genesee river at St. Helena, and one on Genesee river at Rochester. It is believed that these gages will result in a considerable increase in the accuracy of the data obtained and that the results will largely determine future methods of stream gaging, not only in New York State but throughout the United States.

Records are now being obtained from fifteen rain fall stations, ten of which were established in 1910. Standard large size thermometer shelters were installed at three of the new stations and at four of the old stations that formerly were equipped with small shelters.

Except preliminary reconnoissance, practically nothing has been done concerning evaporation. It is expected that this work will be taken up in early spring and a complete station installed somewhere in the vicinity of Albany.

Following is a list of gaging stations maintained by the above co-operative agreement, except Indian Lake, which is still maintained by the State Engineer, and Mechanicville, which record is furnished complete by R. P. Bloss, engineer for West Virginia Pulp and Paper Company. Stations marked with the asterisk were previously maintained by the State Engineer in co-operation with the U. S. Geological Survey, but on account of lack of funds for that co-operation and the fact that the Water Supply Commission were making special studies in their drainage basins, the stations were transferred to the Water Supply Commission fund July 1, 1910.

The standard methods of the United States Geological Survey have been used in making gagings at these stations. The results are given below, as far as available as this time:

- (1) Station description.
- (2) List of current meter discharge measurements.
- (3) Daily gage heights.
- (4) Estimated daily discharge.
- (5) Estimated monthly mean, maximum and minimum discharges.

LIST OF GAGING STATIONS MAINTAINED IN 1910.

Hudson river at North Creek, September 21, 1907-1910.

Hudson river at Thurman, September 22, 1907-1910.

Hudson river at Mechanicville, December, 1888-1910.

Indian lake reservoir at Indian Lake, July 22, 1900-1910.

Champlain canal and Glens Falls feeder.

Schroon lake at Pottersville, July 8, 1908-1910.

Schroon river at Riverbank, September 23, 1907-1910.

Sacandaga river at Wells, August 26, 1907-1910.

Sacandaga river at Northville, August 26, 1907-1910.

Sacandaga river at upper bridge, near Hadley, September 13, 1907-1910.

Sacandaga river cable station near Hadley, November 12, 1910.

Sacandaga river, Union Bag and Paper Company's mill at Hadley, September 24, 1909-1910.

West Branch Sacandaga river at Whitehouse, August 20, 1910.

Cattaraugus creek at Versailles, September 23, 1910.

Genesee river at St. Helena, August 14, 1908-1910.

Genesee river at Jones' Bridge, near Mount Morris, May 22, 1903-1906-1908 -1910.

*Genesee river at Elmwood avenue, Rochester, February 9, 1904-1910.

Canaseraga creek at Dansville, July 21, 1910.

Canaseraga creek at Shakers Crossing.

Keshequa creek at Sonyea, July 22, 1910.

*Salmon river at Fox's Bridge, near Pulaski, September 5, 1900, to December 6, 1908, July 14, 1910.

Moose river at Moose River, June 5, 1900-1910.

*Oswegatchie river near Ogdensburg, May 16, 1903-1910.

Raquette river at Raquette Falls, near Coreys, August 27, 1908-1910.

Raquette river at Piercefield, August 20, 1906-1910.

*Raquette river at Massena Springs, September 21, 1903-1910.

Bog river near Tupper Lake, August 24, 1908-1910.

St. Regis river at Brasher Center, August 22, 1910.

Ausable river at Ausable Forks, August 27, 1910.

ACCUBACY AND RELIABILITY OF FIELD DATA.

Practically all discharge measurements made under fair conditions are within 5 per cent. of the true discharge at the time of observation. Generally speaking, the errors in meter measurements are largely compensating; therefore the mean rating curve, when well defined, is considered much more accurate than the individual measurements.

The work is, of course, largely dependent upon the reliability of the observers. With but few exceptions the observers perform their work honestly. The observations are made twice each day — morning and evening. While these do not always give the mean height for that day, these errors also are compensating and can be considered as negligible for a period of one month, although a single day's reading may, when taken by itself, be considerably in error.

In order to give engineers and others information regarding the probable accuracy of the computed results, footnotes are added and an accuracy column is inserted in the monthly-discharge table. The accuracy column does not

apply to the maximum or minimum, nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, the probable reliability of the observer, and knowledge of local conditions. In this column, A indicates that the mean monthly flow is probably accurate within 5 per cent.; B, within 10 per cent.; C, within 15 per cent.; D, within 25 per cent. Special conditions are covered by footnotes.

HUDSON RIVER DRAINAGE BASIN. Description.

The principal sources of Hudson river lie in the wildest portion of the Adirondack mountains, in Essex county, northeastern New York. A number of branches, any one of which might possibly be considered the main stream, form its upper waters; but if the highest collected and permanent body of water be assumed as the true head, then the source of the Hudson becomes Lake Tear-of-the-Clouds, which lies at an elevation of 4,322 feet above tide, in the center of the triangle formed by Mount Marcy and Skylight and Gray Peaks.

The river flows rather irregularly southward until it reaches the northern boundary of Saratoga county, where it makes a sharp turn and flows eastward for about 12 miles, passing through the mountains and forming, as it cuts across the rocky strata, several falls of great height and beauty. At Sandy Hill, just below Glens Falls, it makes another abrupt turn and flows southward, continuing in this direction until it empties into New York bay.

From Lake Tear-of-the-Clouds to the mouth of the river the distance by water is probably about 300 miles. The total area drained is 13.366 square miles. The river is tidal to Troy, which is also at the head of navigation.

The headwater region is mountainous in character, is in general heavily wooded, and is dotted with numerous lakes and ponds. The rocks, belonging to the oldest formation and mainly granitic, are either bare or covered only with a layer of spruce duff, humus, and forest litter. The river emerges from the mountain region a few miles west of Glens Falls, and thence to Troy the topography is moderately rolling and the surface soil is chiefly sand. Below Troy the river follows the great depression which extends almost due north and south between New York bay and the St. Lawrence, flowing in an open valley bordered by well-cultivated lands, which rise with moderate slope from the stream. The Catskill Mountain region is reached 20 or 30 miles below Albany, and thence to the mouth of the river the immediate valley is flanked by high hills, the Highlands of Orange county and the precipitous Palisades being especially noticeable.

The fall in the upper portion of the course is very rapid, amounting to about 64 feet per mile from Lake Tear-of-the-Clouds to the mouth of North creek, a distance of about 52 miles. From the mouth of North creek to the mouth of the Sacandaga the descent is nearly 14 feet per mile, distributed among rapids which diminish in frequency as the Sacandaga is approached. In the succeeding 26 miles to Fort Edward the river descends 418 feet more, but of this 175 feet is comprised within the three abrupt pitches at Palmer, Glens, and Bakers Falls, while most of the remainder occurs in the rapids between Jessup's Landing and the oxbow above Glens Falls. Between Glens Falls and Troy nearly the entire fall of the river is utilized for the development of water power.

The tributaries of the Hudson are numerous, and many of them are large and important. Indian river, Schroon river, and the Sacandaga unite with the main stream above Glens Falls, and between the latter point and Troy it receives Batten Kill, Fish creek, Hoosic river, and the Mohawk, the latter having several important tributaries, including West and East Canada and Schoharie creeks. The tributaries below Troy include Catskill, Esopus, and Rondout creeks, and Wallkill river from the west, and Kinderhook creek, Jansen Kill, Wappinger creek, Fishkill creek, and Groton river from the east.

The mean annual precipitation on the total basin of the Hudson is probably about 43 inches. It reaches a maximum of more than 55 inches in the heights of the Adirondacks, while in the eastern portion of the drainage area in southern Vermont, the mean annual total is only about 39 inches. Conditions during the winter period vary from the extreme cold and deep snow of the Adirondacks to the areas in the southern portion of the basin which are subject to frequent winter thaws.

The flow of the Upper Hudson is controlled to some extent during the dry season by the use of Indian Lake storage reservoir, and the natural storage facilities in the Adirondack region are unsurpassed, there being a great many ponds and lakes, many of large size and fed from extensive drainage areas. Comprehensive plans for vast storage projects on the Sacandaga, Schroon, and Upper Hudson are receiving the attention of the New York State Water Supply Commission. It is probable that on the various tributaries of the Hudson an increase in storage capacity of some 75 billion cubic feet is possible, and if this were developed the Hudson would be probably the most important water-power stream in the country. While a large amount of power has been developed in the Hudson drainage area there are vast quantities as yet unutilized, and the importance of this river basin is apparent, when it is considered that in proportion to its size it contains a greater population than any other important drainage basin in the United States with the single exception of that of the Delaware river.

The longest run-off record in the Hudson river drainage basin is that obtained at Mechanicville, which extends back to 1888.

Hudson River at North Creek, N. Y.

This station is located on the steel highway bridge at North Creek. It was established, in co-operation with the New York State Water Supply Commission, September 21, 1907, to obtain general statistical and comparative data in regard to the flow of the Hudson.

North creek, a small tributary of the Hudson, enters from the right a short distance below this point.

The datum of the chain gage attached to the bridge has remained the same during the maintenance of the station. During the winter months the discharge is affected by the presence of ice. Conditions for obtaining the accurate discharge are good, and a very good rating curve has been developed. All discharge measurements are made from the bridge.

The regimen of flow of the Upper Hudson, especially during the low-water season, has been considerably affected by storage in Indian Lake reservoir. (See Indian lake at Indian Lake.)

Information in regard to this station is contained in the annual reports of the United States Geological Survey.

Discharge measurements of Hudson river at North Creek, N. Y., in 1910.

APPENDIX E.

DA	TE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
Jan. Feb. April April April June July Nov. Dec.	19 16 2 6 21 17 12 11	C. C. Covert	Pect. 240 252 247 248 248 248 248 210	Sq. ft. 320 556 1,680 1,070 778 668 480 530 440	Pt. per sec86 1.17 5.94 3.92 2.44 2.12 1.37 1.58 1.26	Feet. 3.32 4.60 7.23 5.08 3.80 3.48 2.62 3.01 3.02	Sec. ft. (a)276 (b)652 9,980 4,200 1,900 1,420 645 835 (c)556

(a) Measurement made under complete ice cover. Gage height to top of ice, 3.35 feet; average thickness of ice, 1.3 feet.
(b) Measurement made under complete ice cover. Gage height to top of ice, 4.93 feet; average thickness of ice, 1.95 feet.
(c) Measurement made under partial ice cover. Gage height to top of ice, 3.03 feet; average thickness of ice, 1.2 feet.

Daily gage height, in feet, of Hudson River at North Creek, N. Y., for 1910. [Gilbert Dean, observer.]

DAY.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	3.01			7.20	3.90	4.65	2.52	2.92	3.05	2.95	3.55	2.9
				7.15	4.22	4.40	2.49	2.86	3.22	2.78	3.50	2.8
			(a)6.3	6.25	4.52	3.98	2.45	2.88	3.15	2.69	3.50	2.9
• • • • • • • • • • • • • • • • • • •			(a)6.55		5.25	3.78	2.42	3.12	3.20	2.64	3.48	2.9
• • • • • • • • • • • • • •		4.41	(a)5.75		5.08	3.72	2.37	3.40	3.20	2.64	3.18	2.8
• • • • • • • • • • • • • • • • • • •			(a)5.15		4.58	4.00	2.34	3,20	3,37	2.63	3.45	2.8
•••••			(a)5.17	5.42	4.62	4.57	2.30	3.05	3.55	3.35	3.45	2.7
• • • • • • • • • • • • • •	3.12	••••	(a)5.19		4.52	4.79	2.30	2.82	3.62	3.28	3.25	2.9
• • • • • • • • • • • • • • • • • • •	· · · · · · · ·		(a)5.02		5.08	4.67	2.27	2.70	3.50	3.20	3.10	3.0
• • • • • • • • • • • • • • • • • • •		• • • • •	(a)4.78	4.20	4.28	4.37	2.21	3.38	3.42	3.24	3.0 2.95	3.0 3.0
•••••		4.52	(a)4.60 (a)4.44	4.75	3.70	4.19	2.68	4.00	3.10	3.22	2.98	2.8
••••••		3.02	(a)4.12	4.28	3.48	4.07	2.68	3.58	3.04	3.22	2.90	2.7
• • • • • • • • • • • • • • • • • • •			(a)3.95	4.01	3.52	3.85	2.65	3.32	3.02	3.20	2.84	2.8
• • • • • • • • • • • • • • • • • • •	3.12		(a)3.85	3.00	3.35	3.72	2.60	3.00	2.98	3.12	2.79	2.8
• • • • • • • • • • • • • • • • • • •		4.60	(a)3.68	3.88	3.15	3.57	2.64	3.30	2.90	3.05	2.75	2.8
• • • • • • • • • • • • • • • • • • •		2.00	(a)3.61	2.72	3.02	3.46	2.64	3.20	2.84	3.02	2.70	2.7
• • • • • • • • • • • • • • •			(a)3.50	3.48	2.92	1:64	2.64	3.20	2.80	3.02	2.60	2.8
		4.50	(a)3.48	3.85	3.00	1.75	2.60	3.15	2.78	3.18	2.54	2.9
• • • • • • • • • • • • • •			(a)3.42	5.98	3.02	3.55	2.60	3.08	2.76	3.20	2.40	3.0
			(a)3.50	4.52	3.26	3.48	2.60	2.95	2.76	3.18	2.28	2.8
	4.25		(a)3.66	3.68	3.32	3,30	2.61	2.95	2.80	3.22	2.93	2.8
			4.18	4.28	3.45	3.10	2.60	2.95	2.77	3.25	2.95	2.6
. 			4.18	3.38	3.35	2.98	2.60	2.90	2.75	3.30	2.95	2.9
			5.40	3.68	3.68	2.88	2.60	2.84	2.74	3.28	2.95	2.9
. 		4.80	6.30	3.22	4.84	2.78	2.59	2.81	2.79	3.35	2.94	3.0
			5.90	4.90	5.45	2.75	2.56	2.80	2.85	3.60	2.98	3.1
• • • • • • • • • • • • • • • • • • • •	<u>.</u> . <u></u>		5.55	3.50	4.68	2.70	2.62	2.80	3.36	3.70	2.92	3.1
• • • • • • • • • • • • • • • • • • •		• • • • •	6.12	3.18	4.25	2.62	2.90	2.79	3.40	3.80	2.90	3.0
••••••••••••••••••••••••••••••••••••••		[· · · · ·	6.82 7.08	5.42	4.05	2.55	2,85	2.76	3.15	3.72	2.91	3.0 3.0

⁽a) Readings taken to top of ice.

NOTE.— Ice conditions prevailed January 1 to March 22; and from November 22 to December 31. Log jams during this period effect gage heights. Gage heights for June may be slightly low.

Daily discharge, in second-feet, Hudson River at North Creek, N. Y., for 1910.

DAY.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	450			9,790			474	810			1,550	450
2	425			9,640			454		1,120		1,480	443
3	420			7,080			430		1,040		1,480	490
	400			5,200				1,010			1,450	46
5	375			4,860				1,350			1,080	41.
5	350			4.850				1,100			1,420	38
7	325			5,020			340			1,280		36
3	300			5,730			340			1,200		51
	300	625	3,300	3,580	4,260	3,420	325		1,480		990	53
0	300			2,570			310		1,380		890	53
	300			3,330				1,320	1,160	1,200	840	54
2	300	642	2,300	3,580	1,770	2,550	594	2,240	990	1,120	870	41
3	300	644	2,100	2.710	1,350	2,350	594	1,590	930	1,120	790	35
	300	646	2,000	2,260	1,500	2,000	570	1,250	910	1,100	736	39
	300		1,800		1,280		530	890	870	1,010	691	42
	300	652	1.700	2,050	1,040	1,580	562	1,220	790	940	655	39
	290	640	1,600	628	910	1,430	562	1,100	736	910	610	35
	280	630	1.600	1.450	810	1.680		1,100	700	910	530	41
	275	620	1,600	2,000	890	1.840	530	1,040	682	1,080	488	45
)	400			6,380		1,550		970		1,100	400	53
1	800			3,140			530			1.080	330	43
				1,740			538	840		1,120		43
3	5,400			2,710		990	530			1,160		45
	4,800	700	2.540	1,320	1.280		530			1,220		45
5	4,200			1.740			530			1,200		49
B	3,200			1.120			523			1,280		53
7				3.880			502			1,620		67
8				1.480			546			1.770		62
9				1.080						1,920		57
				5,020						1,800		54
0)			810		1,010			60

MOTE.— Daily discharge during frozen periods determined on the basis measurements made under ice conditions, climatological reports and intercomparison with the discharge obtained at other stations. A well defined rating has been developed for open water period.

Monthly discharge of Hudson River at North Creek, N. Y., for 1910.
[Drainage area, 804 square miles.]

	Discha	RGE IN SEC	ND-FEET.		Depth of	
MONTH.	Maximum.	Minimum.	Menn.	Per square mile.	run-off in inches on drainage area.	Accu- racy.
January. February. March April May June July August	1,290 9,430 9,790 5,080 3,660 810 2,240	275 600 1,600 628 810 495 295 610	1,130 677 4,190 3,560 2,380 1,840 508 956	1.40 .842 5.21 4.43 2.96 2.29 .632 1.19	1.61 .88 6.00 4.94 3.41 2.56 .73	C C A A A A
September. October. November. December. The year.	1,920	646 551 330 350	986 1,130 806 473	1.23 1.41 1.00 .588	1.37 1.63 1.12 .68	A B C

Hudson River at Thurman, N. Y.

This station is located at the Delaware and Hudson Railroad bridge leading from Thurman to Warrensburg, about 950 feet below the highway bridge to Warrensburg, and some 2,000 feet below the entrance of Schroon river into the Hudson. It was established, in co-operation with the New York State Water Supply Commission, September 22, 1907, to obtain general statistical and comparative data regarding the flow of the Hudson river.

There is a dam on Schroon river at Warrensburg, about three miles above the station. On the Hudson there is a dam at Luzerne about twelve miles, below. During the winter months the discharge is affected by ice, and the station discontinued.

The datum of the chain gage attached to the bridge has remained the same during the maintenance of the station. Conditions for obtaining accurate discharge data are excellent, and a very good rating curve has been developed. All measurements are made from the bridge.

The regimen of flow of the Upper Hudson, especially during the low-water season, has been considerably affected by storage in Indian Lake reservoir.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission of New York.

Observation at this station discontinued November 30, 1910.

Discharge measurements of Hudson River at Thurman, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
	W. G. Hoyt W. G. Hoyt W. G. Hoyt	315 308 284 293 279	Sq. ft. 2,050 2,120 1,580 1,200 1,280 1,050 789 881	Ft. per sec. 7.42 7.26 5.89 3.82 3.78 3.01 1.68 2.21	Foet. 7.14 7.28 5.69 4.21 4.30 3.76 2.80 3.23	Secft. 15,200 15,400 9,300 4,580 4,850 3,270 1,330 1,950

Daily gage height, in feet, of Hudson River at Thurman, N. Y., for 1910. [8. H. Spencer, observer.]

DAY.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	No
1	5.90 5.92 6.33 6.85	7, 25 7, 37 6, 52 5, 98 8, 6, 05 5, 71 5, 90 5, 16 4, 72 4, 27 4, 27 4, 31 3, 74 4, 31 3, 3, 42 4, 37 6, 67 4, 41 4, 47 4, 47	4.02 4.63 3.72 4.35 4.23 4.51 4.24 4.50 4.25 4.37 4.34 4.36 3.36 3.37 3.30 4.51 4.51 4.51 4.51 4.51 4.51 4.51 4.51	4.76 4.30 4.30 4.4.70 3.94 4.75 4.79 4.38 4.27 4.37 3.91 3.3.73 3.73 3.73 3.73 3.73 3.58 3.45 3.3.58 3.45 2.98 2.98 2.98 2.98 2.98 2.98 2.98 2.98	2.78 2.249 2.364 2.52 2.50 2.52 2.37 2.496 2.35 2.25 2.25 2.37 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.2	2 85 3 03 2 70 2 62 2 48 2 38 2 38 3 19 3 75 2 86 2 86 2 88 2 58 2 58 2 58 2 58 2 58 2 58 2 58	2.91 2.92 2.97 3.00 3.34 3.13 3.2.90 2.90 2.64 2.55 2.65 2.55 2.55 2.55 2.55 2.55 2.55	2.85 2.64 2.65 3.00 2.94 3.01 2.95 2.97 2.90 2.91 2.95 2.95 2.95 2.95 2.95 2.95 3.01 3.01 3.01 3.03 3.04 3.03 3.03 3.03 3.03 3.03 3.03	3.33.33.33.22.22.22.22.22.22.22.22.22.22

Nors.— Gage heights missing April 25-30.

Daily discharge, in second-feet, of Hudson River at Thurman, N. Y., for 1910.

DAY.	Mar.	April.	May,	June,	July.	Aug.	Sert.	Oct.	Nov
		15,400	4,070	6,220	1,260	1,000	1,160	1,380	2,11
		15,900	5,830	5,740	864	1,080	1,490	1,130	2.01
		12,500	3,280	4,860	720	829	1,510	1,200	2.03
		10,600	5,000	4,290	700	1,380	1,450	1,060	2.0
		10,400	4,660	3,850	1,130	1,720	1,600	1,070	2.20
		8,350	5,470	4,980	988	1.450	1,660	950	2.3
		9,380	4,690	6,190	950	1,140	1,940	1,660	2.2
		10,100	5,440	6,310	900	1,030	2,380	1,580	2.0
		7,480	4.720	6,040	730	852	1,920	1,550	2,8
		6,100	5,060	5,920	643	740	1.820	1,680	1.7
		4,770	4,980	5,060	710	1.060	1,530	1.640	1.5
		5,770	3,690	5.090	690	2,470	1,470	1,490	1.4
		4,890	3.160	4.770	962	2,050	1,330	1,560	1,2
. .		3,330	3,160	4,210	864	3,360	1,220	1,600	1.2
		3,710	3,090	3,770	829	1,230	1,060	1,470	1.3
		4,260	2,470	3,300	710	1,400	962	1.260	1.2
		2,800	2,220	3,300	643	1,440	988	1.300	1.0
		2,570	2,310	3,280	875	1,420		1.330	
		5,060	1,940	4,350	875	1,400	1,000		9
• • • • • • •			1,820	3,180	852		1,110	1,490	8
		10,500				1,130	950	1,560	8
		5,950	2,380	2,940	829	980	950	1,550	7
		5,180	2,220	2,640	806	829	1,030	1,400	. 8
		6,220	2,450	2,290	772	975	938	1,470	1,2
		5,210	2,520	1,920	600	. 975	962	1,700	1,2
		5,040	3,280	1,780	772	975	1,070	1,740	1,2
.		4,870	6,040	1,620	730	900	1,160	1,680	1,1
	10,100	4,710	6,010	1,560	660	829	1,230	2,220	1,1
	10,200	4,550	5,470	1,550	643	652	2,430	2,360	1,1
	. 11,700	4,390	4,690	1,510	900	900	2,270	2,430	1.2
	13,800	4,230	4,740	1,420	794	875	1,960	2,380	1,2
	15,200		5,740		1,000	840		2,380	

Monthly discharge of Hudson River at Thurman,	N.	Y., for 1910.
[Drainage area, 1,550 square mil	8 6.]	

	Disc	Depth of				
MONTH.	Maximum.	Minimum.	Mean.	Per square mile.	inches on drainage area.	Accu-
January. February March April May June July August September October November December	15,900 6,040 6,310 1,260 3,360 2,430	2,570 1,820 1,420 600 652 938 950 772	(1,650) (1,300) (7,600) (7,600) 6,810 3,950 3,800 819 1,220 1,420 1,590 1,490 (860)	(1.06) (.839) (4.90) 4.39 2.55 2.45 .528 .787 .916 1.03 .961 (.555)	(1.22) (.87) (5.65) 4.90 2.94 2.73 .61 .91 1.02 1.19 1.07 (.64)	CCCAAAAAAAC
The year	15,900	600	2,710	1.75	23.75	

NOTE.— Discharge during frozen period, January, February, March and December, 1910, was determined on the basis of the combined flow of the Hudson river at North Creek and the Schroon river at Riverbank plus an estimated inflow.

Hudson River at West Virginia Pulp and Paper Company's Mill, Mechanicville, N. Y.

A record of the flow of Hudson river at Mechanicville has been kept at the Duncan dam since December, 1888. The record includes two daily readings of the depth on the crest of the dam, and a continuous record of the run of the water-wheels in the adjoining paper mill. During the summer of 1909 a self-recording gage was established at this station for the purpose of more accurately registering the daily flow over the crest of the dam. The accompanying tables, computed by Mr. Bloss, the engineer of the West Virginia Pulp and Paper Company, show the daily and monthly mean flow at Mechanicville.

The dam at Mechanicville was raised during 1904, a concrete crest and apron being added, so that the dam has now a rounded or ogee section. A discharge curve has been calculated, using co-efficients of discharge derived from United States Geological Survey experiments on models of dams of ogee cross-section.

The discharge of the Hudson at Mechanicville is diminished somewhat by water required in operating the Champlain canal.

Records at this station are under careful supervision and are regarded as good.

In using these records for comparisons it should be borne in mind that there is a diversion into the Champlain canal at this point. An account of this diversion may be found in this report under Champlan Canal.

Discharge measurements of Hudson River at Mechanicville, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
April 9		Feet. 475 474 476 443 430 472 464	Sq. ft. 6,550 5,920 5,610 4,560 4,930 5,010 4,960	Ft. per sec. 3.35 2.92 2.44 .268 .59 .42 .60	Feet. 4.08 2.63 2.14 .06 1.02 .68 1.00	Secft. 22,000 17,300 13,700 1,700 2,900 2,130 2,970

Note.— Measurements are made from toll bridge below Duncan Dam. Construction work in connection with the Barge Canal has affected conditions somewhat. Measurements represent flow at the time of making.

Daily discharge, in second-feet, of Hudson River at Mechanicville, N. Y., for 1910.

AY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
					100							
 .	1,533	5,570	31,537	35,906	15,760	14,750	3,615	2,625	1,370	4,395	3,885	2,943
	1,331				11,459		3,588	1,562	1,238	3,224	3,453	2,467
	1,369	4,293	29,683	37,809	11,422	12,967	700	1,646	1,490	3,698	3,582	2,288
.	804		29,988			11,628	1,284	1,459	809	2,880	3,667	2,194
	925	3,904	28,355	25,540	12,996	8,173	2,979	2,333	1,488	2,274	4,059	2,499
. .	1,745	2,550	25,211	23,072	12,485	14,025	2,640	2,402	2,658	2,314	3,477	1,668
	2,806	4,915	28,962	23,409	11,353	16,010	2,255	2,425	2,807	2,281	6,071	2,190
	2,163	3,814	29,088	23,808	9,367	17,227	1,949	3,365	2,685	1,533	5,082	1,805
	1,982	3,345	24,586	23,659	11,015	16,959	1.742	2,355	2,899	1,664	4,513	1,745
	1,928	2,742	22,302	17,722	9,227	15,728	812	1,796	3,261	2,770	4,394	1,834
	1,883	2,745	19,691	16,128	9,563	14,300	1,631	2,498	3,400	3,557	3,692	544
	1,489	3,106	18,559	13,510	8,527	14,028	1,421	1,748	3,500	2,027	3,598	1,552
	1,528	3,170	15,818	14,426	7,355	14,848	1,464	2,993	2,134	2,896	2,310	1,240
	1,864	5,765	17,295	12,555	6,176	12,791	1,463	2,658	2,393	2,692	4,403	1,260
	1,866		14,250		4,534	11,450	1,430	2,758	2,717	2,702	3,202	1,468
	2.134	3,858	12,778	9,429	7, 166	9,759	1,385	2,061	2,701	1,378	2,570	1,448
	1,433	3,156	11,774	8,469	5,696	8,896	800	2.097	2.075	2,725	2,919	1.780
	1,720	4,032	10,603	8,014	5,228	9,046	1,595	2,165	345	2,388	3,013	1,129
	2,638	3,381	9,193	8,830	5,008	8,827	1,394	2,555	2,080	1,765	2,130	1,466
	4,583	2,483	9.684	13,313	4,795	9,760	1,328	2,527	1,766	1,926	1,180	1,780
	2,733		12,197	18,413	5,345	7,546	1,332	796	1,604	1,242	2,533	1,376
	31,151	5,528	12,314	14,457	5,450	6,761	1,412	1,874	1,595	1,542	2,370	1,725
	15,692	6.002	12,622	12,279	7.341	6,078	1,465	2,389	1,429	900	2,159	1,432
	12,370		14,714		6,312	5,425	530	1,488	1,541	1,846	2,523	1,492
	11,513	5,276	16,946	11,827	6,681	4,872	1,382	1,185	1,036	3,548	2,098	764
	11,644	4,694	27,319	10,360	9,397	3,283	1,395	1,629	1,987	2,800	4,771	3,234
		10,742	28,173	16,735	13,668	5,064	1,473	2,212	1,537	2,584	2,181	2,555
			28,924			3,825	1,406	867	2,744	3,335	2,799	3,191
			27,375	13,283	11,823	3,539	1,701	867	4,737	2,471	3,712	3,791
			29,529			3,064	1,410	1,180	6,143	3,152	2,069	3,746
	7,135		33, 162		14,981	66284	717	1,243		4,289	22.44	3,601

Monthly discharge of Hudson River at Mechanicville	. <i>N</i> .	Y., for 1910.
Drainage area, 4,500 square miles	.1	

		Depth of			
MONTH.	Maximum.	Minimum.	Mean.	Per square mile.	run-off in inches on drainage area.
January. February March. April May June July August September October. November December.	37,700 33,200 37,800 15,800 17,200 3,620 3,360	804 2,480 9,190 8,020 4,540 3,060 530 867 345 900 1,180	5,190 5,480 21,400 17,600 9,230 10,200 1,600 1,990 2,270 2,530 3,280 2,010	1.15 1.22 4.76 3.91 2.05 2.27 .356 .442 .504 .662 .740	1.33 1.27 5.49 4.36 2.36 2.53 .41 .51 .65 .65
The year	37,700	845	6,900	1.53	20.82

Indian Lake Reservoir at Indian Lake, N. Y.

This station is located at a masonry storage dam at the outlet of Indian lake. It was established July 22, 1900, to determine the total outflow from this reservoir. The drainage area at this point is 131 square miles, including about 9.3 square miles of water surface of Indian lake at the elevation of the spillway of the dam.

The flow of the Upper Hudson has been controlled to a considerable extent during the dry season by the use of Indian Lake reservoir, since its completion in 1899. The total storage provided is about 4.7 billion cubic feet, which affords a discharge of nearly 600 second-feet for a period of 90 to 130 days each year.

The record of this station includes the elevation of the water surface in the reservoir, the depth of water flowing over the spillway or flashboards, the depth of opening and the head on the main and subsidiary logways, and the depth of the opening and the effective head on each of the five-foot sluice gates. A meterological station has also been established at the dam by the United States Weather Bureau, and records are kept of the rainfall, temperature, etc.

The crest of the dam is 106.65 feet long in the clear. To facilitate the calculation of discharge over the spillway, a series of experiments was made at Cornell University in 1899 on a full-sized model of the spillway section, 6.58 feet long, from which the co-efficient of discharge has been determined.

No computations of discharge have been made pending some current meter measurements to rate discharge through gates, and at present the record of reservoir level alone is available.

The datum of the gage has remained the same during the maintenance of the station. The elevation of the spillway crest above mean tide is 1,650 feet.

The maximum gage height of Indian Lake reservoir since the establishment of this station occurred April 27, 1908, and was 37 feet. The minimum gage height was 2 feet and occurred from March 9 to 18, 1907.

Information in regard to this station is contained in the annual reports of the United States Geological Survey, and of the State Engineer and Surveyor, State of New York.

The station is maintained in co-operation with the State Engineer and Surveyor.

Daily gage height, in feet, of Indian Lake at Indian Lake, N. Y., for 1910.
[Lester Severie, observer.]

DAY.	Jan.	Feb.	Mar.	April.	Мау.	June.	July.	Aug.	Sept.	Oct.	Nov	Dec.
1	2.17 2.08 2.00 2.00 2.00 2.00 2.00 2.00 2.00	6.25 6.42 6.62 6.75 6.88 7.00 6.88 6.66 6.25 5.29 9.50 4.88 4.25 4.42 4.43 3.83 3.32 4.43 4.45 4.46	6.17 7.83 9.08 9.83 10.42 10.75 11.08 11.54 12.21 12.58 12.75 12.92 13.04 14.00 14.00 14.00 14.00 14.54 15.17 17.25 18.00 18.00	21.00 21.79 22.42 23.00 23.42 23.92 24.33 25.50 25.53 25.50 25.13 25.25.83 25.60 27.67 28.42 29.25 29.25 29.25 29.25 30.33 30.50 30.33 30.50 30.67 30.88	30.96 31.13 31.46 31.88 32.23 32.38 32.50 32.63 32.71 32.79 33.08 33.13 33.17 33.25 33.38 33.38 33.38 33.46 33.58 33.46 33.58 33.46 34.58 34.58 34.58 34.58	34.75 34.75 34.71 34.71 34.88 35.08 35.21 35.17 35.17 35.17 35.08 35.00 34.92 35.00 34.92 34.83 35.00 34.92 34.83 35.00 34.92 34.83 35.00 34.92 34.83 35.00	34 . 29 34 . 25 34 . 25 34 . 21 34 . 12 34 . 12 34 . 12 33 . 92 33 . 83 33 . 67 33 . 82 33 . 83 33 . 29 33 . 29 32 . 79 32 . 67 32 . 29 32 . 29 32 . 29 31 . 67 31 . 67 31 . 67 31 . 33 31 . 79 31 . 67 31 . 33	30 . 79 30 . 58 30 . 58 30 . 62 30 . 62 30 . 71 30 . 83 30 . 75 30 . 83 30 . 75 30 . 83 30 . 75 30 . 83 30 . 75 30 . 83 30 . 92 31 . 108 31 . 121 31 . 08 30 . 83 30 . 83 29 . 82 29 . 82 8 . 84 8 84 8	27 .92 27 .67 27 .42 27 .17 26 .92 26 .75 26 .58 26 .42 25 .25 .67 25 .25 .25 25 .25 .25 24 .54 23 .75 24 .23 24 .23 23 .75 22 .75 22 .75 22 .75 22 .75 22 .75 23 .38	23.46 23.54 23.67 23.87 23.88 23.71 23.54 23.48 22.38 22.38 22.17 22.00 21.83 22.167 22.00 21.83 20.75 19.75 19.42 11.75 18.42 11.75 18.42 17.17 17.17	16.83 16.67 16.50 16.65 16.68 17.04 17.17 17.25 17.33 17.42 17.50 17.58 17.67 17.75 17.83 17.92 18.00 17.75 17.83 17.92 18.04 17.04 18.04 17.04 18.04 17.04 18.88 17.04 16.88 17.04 16.88	16.08 15.92 15.75 15.58 15.42 15.25 15.04 14.68 14.48 14.33 14.21 13.54 13.71 13.54 13.21 13.54 13.21 13.54 13.21 13.54 13.21 13.54 13.21 13.54 13.21 13.54 13.21 13.54 13.21 13.54 13.21 13.54 13.38 13.21 13.54 13.38 13.21 13.54 13.38 13.21 13.54 13.38 13.21 13.54 13.38 13.21 13.54 13.38 13.21 13.54 13.38 13.21 13.54 13.38 13.21 13.54 13.38 13.21 13.54 13.38 13.21 13.54 13.38 13.21 13.54

Gate openings, in feet, of Indian Lake Reservoir at Indian Lake, N. Y., for 1910.

DATE.	Sluice gate A open.	Sluice gate B open.
	Feet.	Feet.
January 1 to February 28		
July 1 to July 11	2.6	
August 1 to August 4		
August 5-6	2.0	
August 9–10		
August 11	2.0	
August 16	2.0	
August 17 to September 27a	5.0	
October 5 to November 1		5.0
October 18 to November 3	2.6	
November 2–3	1	2.0
December 5-10	2.6	
December 1-31	1	5.0

a Main logway open about 9 feet August 31 to September 20, and open 15 feet September 21 to 30

Champlain Canal and Glens Falls Feeder, N. Y.

The discharge of Hudson river at both Fort Edward and Mechanicville is diminished somewhat Ly the water required for operating the Champlain canal. In the northern portion of this canal—from Northumberland to Lake Champlain, at Whitehall—the summit level (between Fort Edward and Fort Ann) is supplied (1) by the Glens Falls feeder, a branch canal, leaving the Hudson about 2 miles above Glens Falls, and (2) by Wood creek.

At Northumberland the canal crosses the Hudson and the southern portion receives its principal water supply here.

The quantity of water diverted from Hudson river for the Champlain canal has been measured occasionally during 1910 at various points and a summary of these measurements follows:

Measurements of flow in Champlain Canal, Glens Falls Feeder and spillways in 1910.

No.	Date.	. LOCALITY.	Mean veloc, (ft. per second)	Discharge (second feet).	Remarks.
1 2 3 4 5 6 7 11 9 12 13 1	June 2 June 2 June 2 June 2 June 2 June 2 June 3 Sune 2 June 3 June 3 Sune 2 Sune 3 Su	Below Northumberland. Champlain Canal at Mechanicville. Spillway near Mechanicville. Bridge 34, Stillwater. Spillway below bridge 34 Schuyler Creek near Stillwater. Spillway at Bemis. Bridge 45 below Coveville. Coveville foot bridge. Spillway below Coveville. Champlain Canal, Schuylerville Spillway below Schuylerville Lock at head of canal Champlain Canal at Mechanicville.	.60 .33 .62 .48 	. 5 75.4	Estimated. Estimated. Estimated. Estimated. Estimated. Estimated.
14 15 (a) 17 18 20 20 16 20 16 20	June 3 June 4 June 3 June 4 June 4 June 15 June 15 June 15 Aug. 12 Sept. 26 Oct. 14 Oct. 14	Above Northumberland. Lock at end of Canal. Champlain Canal at Fort Edward. Glens Falls Feeder, Hudson Falls. Spillway above Fort Edward. Champlain Canal above Feeder Br. No. 100. Glens Falls Feeder above Glens Falls. Champlain Canal, Maple St. Br. above Br. 100. Glens Falls Feeder above Glens Falls. Glens Falls Feeder, Hudson Falls. Glens Falls Feeder, Glens Falls. Glens Falls Feeder, Hudson Falls. Glens Falls Feeder, Hudson Falls. Glens Falls Feeder, Glens Falls. Glens Falls Feeder, Glens Falls.	.42 .97 .36 .87 .22 .75 .56	5 110 195 5 135 216 74.5 123 208 182 190 188 210	Estimated.

⁽a) Brown Bridge.

Descriptions of measuring points. Numbers correspond with points at which measurements have been made.

- 1. Made from Saratoga Street bridge.
- 2. This spillway is about 250 yards above mill of West Virginia Pulp Company at Mechanicville; is 90 feet across; water flowing over about 1/2 inch in depth.
- 5. Schuyler creek flows into the canal opposite the Stillwater spillway; no measurement of this could be made, but estimated flow was 10 or 15 second-feet.
 - 6. Measurement from bridge at Stillwater.
 - 7. Measurement from bridge No. 45, opposite W. F. Curtis's.
- 8. Spillway between bridges Nos. 46 and 47; not sufficient flow for measurement. Estimated at 5 to 8 second-feet.
 - 9. Spillway just above bridge No. 51; estimated flow at 1 second-foot.
- 10. Small spillway 75 yards below Coveville; estimated flow 4 to 5 second-feet.
 - 11. Measurement from footbridge behind Coveville post-office.
- 12. Measurement from bridge No. 63. There are three spillways just below this bridge.
 - 13. Lock not in use at this time; estimated leakage 4 to 6 second-feet.
 - 14. Lock at end of canal; estimated leakage 3 to 5 second-feet.
 - 15. At East Street bridge, Fort Edward.
 - 16. From Change bridge west of trolley line at Hudson Falls.
- 17. From bridge 45 feet north of entrance of Glens Falls feeder; current runs north.
- 18. There is but one bridge between Fort Edward and Glens Falls feeder, about 150 yards above Fort Edward lock; barely a trace of current here in canal. Estimated flow over lock gates, 10 or 12 second-feet. Between Fort Edward and Glens Falls feeder is one small waste weir; estimated flow over this 1 second-foot.
 - 19. At plate-girder highway bridge at Glens Falls.
 - 20. At Change bridge near feed dam, Glens Falls.

Results of discharge measurements to show diversion from Hudson river for canal purposes above Fort Edward and Mechanicville gaging stations, in 1910.

	Fred	ER AT	CHAMPLAIN CANAL.			
DATE OF MEASUREMENT.	Glens Falls.	Hudson Falls.	Fort Edward.	Above Feeder.	Saratoga street, Mechanio- ville,	
June 2, 3, 4 June 15-21 July 21 August 12-13 September 26. October 14. Mean of observed quantities.	216 177 208 190 210 200	195 (160) 123 178 188 180	88 (72) 55 80 85	107 (88) 68 98 103 94	91 75 164 60.5 88 (90) 96	

From the foregoing table it appears that an average of about 200 secondfeet passes under the first change bridge on the Glens Falls feeder above Glens Falls and an average of 170 second-feet under the Ferry Street bridge at Hudson Falls. This indicates that about 30 second-feet returns to the Hudson river above Fort Edward and that about 170 second-feet enters Champlain canal and is diverted above Fort Edward. It is estimated that about 95 second-feet flows north toward Lake Champlain and is permanently diverted from the Hudson drainage. The remaining 75 second-feet flows south and probably nearly all gets back into the Hudson at or above Northumber-

The supply of water taken for the southern part of the canal below Northumberland is probably about 95 second-feet, which with the 95 second-feet tlowing north into Lake Champlain makes a total of about 190 second-feet to be added to the recorded flow at Mechanicville.

It will be noted that the gagings were made at different times of the canal season so that the usage is shown for the various periods and the average value given for the deductions.

In conclusion, it seems safe to assume, the following values as applicable during that portion of the year when the canal is in operation - May to November, inclusive,

At Fort Edward add 170 second-feet to the recorded flow.

At Mechanicville add 190 second-feet to the recorded flow.

These values are practically the same as found by Mr. Barrows in 1907, and since the measurements cover the period of operation of the canal, except for May and November, they are believed to be approximately correct; any great deviation therefrom would be temporary and due to lockage or breaks in the canal.

MISCELLANEOUS DISCHARGE MEASUREMENTS OF STREAMS IN HUDSON RIVER DRAINAGE BASIN IN 1910.

The following miscellaneous discharge measurements were made in Hudson River drainage basin in 1910: Miscellaneous discharge measurements in Hudson River drainage basin, 1910.

DATE.	Stream.	Tributary to	Locality.	Gage height.	Dis- charge.
Jan. 10.	West branch Sacan- daga river	Sacandaga river above Northville	Highway bridge above mouth of De- vorse Creek, about 21 miles southwest	Foot.	Sec. ft.
Aug. 23.	East Stony Creek		of Wells300 yards above high-		(a)76.9
		Northville	way bridge on road to Wells	(b)12.2	16.1
Aug. 23.	West Stony Creek	Sacandaga river near Northville	Near highway bridge on road to Benson Center		7.4
July 20.	The Branch (Niagara Brook)	Schroon River			• • •
			Ridge	(c)5.62	12.5

⁽a) Measurements made under complete ice cover, average thickness of ice 0.8 feet
(b) Reference point on down stream side of bridge, distance to water surface.
(c) Distance to water surface from nail in maple tree (10 inches diameter) 150 feet below bridge on right bank.

SCHROON RIVER BASIN. Description.

Schroon river rises in Essex county, along the southern slopes of the highest mountains in the Adirondack group, flows in a general southerly direction for about 45 miles through Essex and Warren counties, and joins the Hudson near Thurman. Its total drainage area is 550 square miles. Its headwaters reach an elevation of about 2,000 feet above mean tide, while at its mouth it is at an elevation of about 600 feet.

Its basin is largely forested and contains considerable wild land and numerous lakes and ponds. The most important of these is Schroon lake, through which the river flows, which has water surface area of about 6.3 square miles. The river affords excellent opportunities for storage and power development, which are under investigation by the New York State Water Supply Commission. The only power developments are at Warrensburg.

Schroon Lake at Pottersville, N. Y.

This station is located at the outlet of Schroon lake, 1 mile from Pottersville post-office, and is at the Steamboat wharf. It was established July 8, 1903, in co-operation with the U. S. Geological Survey, to obtain the fluctuations in level of Schroon lake for general statistical and comparative data. It was discontinued December 5, 1908, re-established July 1, 1909, discontinued December 4, 1909, re-established April 17, 1910, and discontinued December 3, 1910.

The gage datum was established at an elevation of 803.75 feet above mean sea level. The ice raised the gage .17 feet during the winter of 1908-1909. A plus correction of .17 feet has been applied to the 1910 readings to make them conform with original gage datum.

Daily gage height in feet of Schroon Lake at Pottersville, N. Y., for 1910.

DAY.	April,	May.	June.	July.	Aug.	Sept.	Oct.	Nov	Dec.
DAY. 1		May. 4.26 4.87 5.07 5.17 5.37 5.37 5.27 5.27 5.07 4.87 4.87 4.47 4.47 4.57 4.57 4.97 5.27 5.27	June. 5.37 5.47 5.47 5.37 5.57 5.57 5.57 5.57 5.47 5.57 5.47 5.07 5.07 4.77 4.77 4.77 4.77 4.77 4.77 4.77 4	July. 2.87 2.77 2.77 2.77 2.67 2.67 2.27 2.07 2.07 1.97 1.97 1.97 1.97 1.97 1.87 1.87 1.87 1.87 1.87 1.87	Aug. 1.87 1.97 1.97 2.02 2.02 2.07 2.17 2.57 2.67 2.57 2.77 2.87 2.87 3.07 3.07 3.07 3.07 3.07 3.07 3.07 3.0	2.67 2.57 2.47 2.47 2.67 2.57 2.57 2.57 2.57 2.57 2.37 2.37 2.37 2.37 2.37 1.97 1.87 1.87 1.87	0et. 1.97 1.87 1.87 1.77 1.67 1.47 1.47 1.47 1.47 1.37 1.37 1.37 1.37 1.37 1.37 1.37 1.3	Nov 1.27 1.37 1.37 1.37 1.37 1.37 1.37 1.37 1.3	1.0° 1.0° 1.0° 1.0° 1.0° 1.0° 1.0° 1.0°

Schroon River at Riverbank, N. Y.

This station is located on the steel highway bridge near Riverbank postoffice, between the towns of Warrensburg and Bolton, about 9 miles north of the village of Warrensburg, and about 10 miles downstream from the outlet of Schroon lake. It was established September 23, 1907, in co-operation with the U. S. Geological Survey, to obtain general statistical data in regard to the flow of Schroon river.

There are several dams at the village of Warrensburg used for power purposes. During September, 1907, a timber crib dam was constructed at Starbuckville, about 6 miles above the gaging station for storage purposes, this affording a head of some 8 feet and ponding water to Schroon lake. Tumble Head falls begin about 1 mile above the gaging station and extend upstream for about a mile further, affording a total fall of some 30 feet.

The datum of the chain gage attached to the bridge has remained the same during the maintenance of the station. During the winter months the discharge is affected by ice conditions. Conditions for obtaining accurate discharge are good, and a very good rating curve has been developed. All measurements are made from the bridge.

Since 1907, the regimen of flow of Schroon river during the low water season has been considerably affected by the storage held in Schroon lake.

Information in regard to this station is contained in the annual reports of the U.S. Geological Survey.

Discharge measurements of	f Schroon	Riner.	at Riverbank.	N.	Y in	1910.
DISCRUTTLE TREASON CINETINS V.	Bullion	460001	the Treated Courses	44.	4 .,	TOTO.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
Jan. 20	W. G. Hoyt. C. C. Covert. W. G. Hoyt. W. G. Hoyt. W. G. Hoyt. W. G. Hoyt. Covert & Phelan F. J. Shuttleworth. F. J. Shuttleworth.	85 85	Sq. Pt. 138 194 593 600 542 508 284 166 224	Ft. per sec. 1.01 1.84 9.90 9.58 8.94 8.64 4.60 1.12 1.34	Feet. 1.73 2.63 7.22 7.19 6.52 6.21 3.54 1.70 2.00	Secft. (a) 139 (b) 358 5,870 5,750 4,840 4,390 1,310 (c) 186 (d) 301

⁽a) Complete ice cover. Gage height to top of ice, 1.83 feet. Average thickness of ice, 1.00 feet. (b) Complete ice cover. Gage height to top of ice, 2.73 feet. Average thickness of ice 1.00 feet. (c) Complete ice cover. Gage height to top of ice 1.70, to bottom, 0.70; average thickness ice 1.88. (d) Complete ice cover. Gage height to top of ice 2.00, to bottom, 90; average thickness ice 1.30.

Daily gage height, in feet, of Schroon Riser at Riserbank, N. Y., for 1910.
[J. H. Roberts, observer.]

		===										
DAY.	Jan.	Feb.	Mar.	April.	Мау.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.6	2.45	3.20	7.22	4.25	4.72	2.75	1.35	1.95	2.20	2.15	1.85
2	1.65	2.45	3.45	7.18	4.18	4.55	1.75	1.45	2.00	2.10	2.20	1.90
3	1.60	2.50	3.65	6.88	4.28	4.30	1.65	1.35	2.10	2.20	2.10	1.95
4	1.60	2.50	3.70	6.52	4.20	4.15	1.75	2.00	2.00	2.15	2.15	1.75
5	1.55	2.45	3.70	6.18	4.28	4.05	2.58	1.60	2.00	2.15	2.30	1.80
6	1.60	2.40	3.75	5.90	4.38	4.15	2.35	1 50	2.10	2.15	2.25	1.80
7	1.65	2.45	3.98 4.22	5.78	4.45	4.12	2.35 2.20	1.45	2.10	2.10	2.30 2.30	1.90 1.85
8 9	1.70 1.75	2.50	4.22	5.62 5.45	4.35	4.35	2.20	1.50 1.50	2.15 2.10	2.05	2.30	1.85
10	1.65	2.50	4.45	5.20	4.30	4.30	2.00	1.45	2.05	2.05	2.30	1.75
11	1.70	2.45	4.52	4.75	4.25	4 15	2.00	1.50	1.95	2.05	2.30	1.70
12	1.70	2.50	4.48	4.30	4.25	4.15	1.65	1.45	2.00	2.10	2.25	1.65
13	1.75	2.60	4.38	4.45	4.20	4.00	1.70	1.40	2.10	2.05	2.15	1.50
14	1.70	2.75	4.22	4.30	4 15	3.72	1.70	1.30	1.55	2.00	2.25	1.55
15	1.70	2.75	4.10	4.20	3.85	3.50	1.60	1.45	1.45	2.00	2.15	1.75
16	1.65	2.60	4.00	4.08	3.85	3.55	1.65	1.50	1.50	1.85	2.10	1.70
17	1.70	2.70	3.90	3.98	3.72	3.50	1.50	1.45	2.00	2.10	2.15	1.65
18	1.70	2.70	3.80	3.72	3.20	3.40	1.55	1.45	1.95	2.10	2.20	1.50
19	2.00	2.75	3.62	3.88	3.20	3.35	1.50	1.45	1.95	2.05	2.20	1.70
20	1.70	2.70 2.65	3.58	4.22	3.15 3.22	3.25 3.20	1.50	1.40 1.40	1.90	2.00 1.90	1.90 2.10	1.70 1.65
21	1.65 2.00	2.85	3.52 3.52	4.65 4.72	3.00	3.15	1.45 1.40	1.45	1.85 1.90	1.95	2.10	1.60
23	2.05	2.80	3.65	4.62	3.12	3.05	1.55	1.65	1.85	1.85	2.10	1.60
24	2.10	2.75	3.92	4.50	3.45	3.00	1.35	1.70	1.85	1.90	1.85	1.80
25	2.20	2.80	4.50	4.48	3.50	2.90	1.40	1.65	2.05	1.95	2.00	1.70
26	2.30	2.75	5.12	4.40	4.25	2.75	1.35	1.60	2.05	1.95	2.00	1.80
27	2.40	3.00	5.48	4.48	4.18	2.95	1.40	1.50	2.15	1.95	1.80	1.80
28	2.45	3.00	5.88	4.42	4.40	2.95	1.40	1.55	2.40	2.10	1.90	1.70
29	2.40		5.18	4.40	4.30	3.00	1.35	1.65	2.35	2.15	1.80	1.75
30	2.50		6.58	4.35	4.60	2.85	1.30	1.60	2.20	2.00	1.85	1.80
31	2.40	J	6.95	'	4.68		1.20	1.80		2.15	1	1.90

REMARKS: Ice conditions prevailed Jan. 1-March 13, and Dec. 8-31.

Daily discharge in Second-feet Schroon River, at Riverbank, N. Y., for 1910.

Dec.	Nov.	Oct.	Sept.	Aug.	July.	June.	May.	April.	Mar.	Feb.	Jan.	DAY.
29	411	432	331	136	694	2,470	1,940	5,460	579	310	160	1
81	432	390	350	164	259	2,270	1,870	5,420	720	310	177	2
33	390	432	390	136	226	2,000	1,970	5,060	858	328	155	Secreta
25	411	411	350	350	259	1,840	1,890	4,620	912	328	153	Same
27	476	411	350	210	608	1,730	1,970	4,220	938	310	140	8,
27	454	411	390	178	499	1,840	2,080	3,880	1,000	297	149	6
31	476	390	390	164	499	1,800	2,160	3,740	1,220	310	165	7
29	476	370	411	178	432	2,050	2,000	3,540	1,400	324	168	8
25	476	350	390	178	432	2,050	2,050	3,340	1,840	324	176	9
20	476	370	370	164	350	2,000	2,000	3,040	1,860	324	158	0
19	476	370	331	178	350	1,840	1,940	2,500	2,020	310	160	deserve.
17	454	390	350	164	226	1,840	1,940	2,000	2,060	324	157	2
14	411	370	390	149	242	1,670	1,890	2,160	2,090	351	166	3
15	454	350	194	122	242	1,400	1,840	2,000	1,910	396	152	4mares
20	411	350	164	164	210	1,200	1,520	1,890	1,780	396	150	5
19	390	294	178	178	226	1,240	1,520	1,760	1,670	352	144	6
18	411	390	350	164	178	1,200	1,400	1,650	1,570	358	145	7
14	432	390	331	164	194	1,120	966	1,400	1,470	381	140	8
19	432	37 0	331	164	178	1,080	966	1,550	1,310	396	196	9
19	312	350	312	149	178	1,000	933	1,910	1,270	381	139	20
18	390	312	294	149	164	966	980	2,380	1,220	366	130	Leaven
16	390	331	312	164	149	933	836	2,470	1,220	426	165	2
16	390	294	294	226	194	868	913	2,350	1,340	411	204	3
22	294	312	294	242	136	836	1,160	2,220	1,590	396	214	4
19	850	331	370	226	149	776	1,200	2,190	2,220	411	237	5
22	350	331	370	210	136	694	1,940	2,100	2,940	396	262	26
22	276	331	411	178	149	806	1,870	2,190	3,380	476	287	7
19	312	390	522	194	149	806	2,100	2,130	3,870	476	300	8
20	276	411	499	226	136	836	2,000	2,100	3,020		287	9
22	294	350	432	210	122	748	2,330	2,050	4,700		312	30
25		411	Corner.	276	97		2,420				287	31

Norm.—Ice conditions prevailed January 1-March 13, and December 8-31. The flow for the period is based on a special curve.

Monthly discharge of Schroon River at Riverbank, N. Y., for 1919. [Drainage area, 534 square miles,]

	Di	Depth of				
MONTH.	Maximum.	Minimum.	Mean.	Per square mile.	inches on drainage area.	Асси- гасу.
January February March April May June June July August September October November	5,140 5,460 2,420 2,470 694 350 522 432 476	130 297 579 1,400 836 694 97 122 164 294 276 140	188 363 1,910 2,780 1,700 1,400 260 186 348 368 399 219	.352 .680 3.58 5.21 3.18 2.62 .487 .348 .652 .689 .747	.41 .70 4.13 5.81 3.67 2.92 .56 .40 .73 .79 .83	CCB A A A A A A A A C
The year	5,460	97	843	1.58	21.42	

SACANDAGA RIVER BASIN.

Description.

Sacandaga river is formed by three principal branches which unite in the southeastern part of Hamilton county in the Adirondack region. The west branch is the outlet of Piseco lake, the middle branch is the outlet of Sacandaga and Pleasant lakes, while the east and principal branch issues from a series of small ponds and lakes in the southwestern part of Warren county. The east and middle branches unite a few miles north of Wells and are joined by the west branch a short distance below Wells. The river then flows southeasterly to about 5 miles below Northville, where it turns and runs northeasterly to the Hudson river at Hadley. Its total drainage area comprises about 1,050 square miles.

Sacandaga lake, the highest of the tributary lakes in the headwaters, is about 1.700 feet above mean tide; at its entrance into the Hudson the Sacandaga is at an elevation of about 550 feet. Between Northville and the mouth of the river there is a fall of about 180 feet (chiefly concentrated in the 5 miles below Conklingville) entirely unutilized. There are, in fact, no power developments on the Sacandaga.

The drainage area of this river is largely in forest. Precipitation is high, the mean for the year being about 49 inches, whereas that of the whole Hudson drainage area above Mechanicville is only about 43 inches. Possibilities for storage on the Sacandaga are great and the State Water Supply Commission of New York propose a high dam at Conklingville, the reservoir to store about 25,000,000,000 cubic feet of water, with a water surface of about 40 square miles, and controlling practically the entire flow of the Sacandaga basin. Their plan proposes also to develop the total fall obtained between Conklingville and the Hudson—approximately 200 feet—which will afford 25,000 to 30,000 continuous horsepower.

Sacandaga River at Wells, N. Y.

This station is located at the steel highway bridge over the east branch of the Sacandaga river in the southern part of the village of Wells, about 21/2 miles above the junction of the east and west branches. It was established August 26, 1907, in co-operation with the U. S. Geological Survey, to obtain general statistical and comparative data regarding the flow of the Sacandaga river.

The datum of the chain gage attached to the bridge has remained the same during the maintenance of the station. During the winter months the discharge is usually affected by the presence of ice. Conditions for obtaining the accurate discharge are good, and a fairly good rating curve has been developed. All measurements are made from the bridge.

Information in regard to this station is contained in the annual reports of the U.S. Geological Survey.

Discharge measurements of Sacandaga River at Wells, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
		Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.
Jan. 9	C. C. Covert	46	95	.71	4.24	(a) 68
Jan. 10	C. C. Covert	46	92	70	4.26	(a)64
Mar. 26	W. G. Hoyt	100	530	7.24	8.5	(6)3,840
Mar. 27	W. G. Hoyt	98	438	6.44	7.58	2,820
Mar. 28	W. G. Hoyt	98	428	6.66	7.55	2,850
Mar. 29	W. G. Hoyt	97	530	7.04	8.5	(b)3,730
April 13	C. C. Covert	90	404	3.56	7.26	(c)1,440
April 14	C. C. Covert	82	258	1.95	5.62	(c)503
June 8	<u>W</u> . G. Hoyt	91	351	4.79	6.54	1,680
June 9	W. G. Hoyt	89	319	4.36	6.30	1,390
July 15	J. J. Phelan	55	111	.49	3.90	55
July 21	J. J. Phelan	56	129	1.15	4.39	148
Oct. 27	W. G. Hoyt	73	172	1.44	4.75	248
Oct. 27	W. G. Hoyt	82	242	2.53	5.39	612
Oct. 28	W. G. Hoyt	80	216	2.27	5.23	490
Dec. 22	F. J. Shuttleworth	65	124	.91	4.60	(d)112

⁽a) Measurements made under complete ice cover. Gage height to top of ice 4.34 feet; average thickness of ice 0.3 feet.
(b) Poor measurements; not enough lead weights for velocities.
(c) Discharge affected by log jam below bridge.
(d) Measurement made under complete ice cover. Gage height top of ice 4.60 feet; average teleness of ice 0.3 foot.

Daily gage height in feet, of Sacandaga River at Wells, N. Y., for 1910.
[Frank Stanyon, observer.]

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.12	5.32	8.48	8.92	5.90	6.98	4.35	3.92	3.95	5.30	4.78	4.38
2	4.12	5.65	8.25	8.55	5.85	6.78	4.36	3.90	4.00	5.12	4.74	4.38
3	4.14	5.56	7.65	7.78	6.00	6.58	4.29	3.92	4.15	4.95	4.78	4.38
4	4.15	5.50	7.12	7.52	6.05	6.51	4.22	4.75	4.68	4.84	5.02	4.38
5	4.18	5.35	6.85	7.62	8.00	6.58	4.19	5.20	4.62	4.72	5.50	4.58
<u>6</u>	4.22	5.90	6.70	7.52	6.00	6.90	4.10	4.70	4.70	4.72	5.48	4.90
7	4.24	6.00	6.75	7.40	6.00	7.20	3.90	4.35	4.58	4.65	5.45	4.98
8	4.25	5.85	6.45	7.05	5.90		4.00	4.22	4.45	4.60	5.38	4.78
9	4.25	5.58	6.34	6.45	5.90	6.10	3.96	4.16	4.35	4.62	5.28	4.62
0	4.25	5.42	6.28	6.45	5.72	5.90	3.90	4.15	4.24	4.58	5.22	4.58
1	4.24	5.42	6.18	6.38	5.68	5.92	3.94	5.02	4.16	4.48	5.14	4.50
2	4.26	5.35	6.02	6.30	5.58	6.20	3.90	4.75	4.10	4.40	5.10	4.58
3	4.26	5.28	5.92	6.80	5.52	6.08	3.89	4.45	4.11	4.50	4.88	4.52
4	4.26	5.30	5.80	6.72	5.52	5.72	3.86	4.28	4.28	4.52	4.78	4.58
5	4.26	5.25	5.65	5.95	5.52	5.48	3.84	4.22	4.22	4.48	4.76	
6	4.26	5.26	5.48	6.05	5.62	5.35	3.88	4.92	4.16	4.44	4.72	4.62
17	4.26	5.21	5.49	6.05	5.52	5.48	4.00	4.82	4.10	4.40	4.72	4.68
8	4.36	5.18	5.44	7.50	5.60	5.58	3.99	4.75	4.05	4.32	4.55	4.68
9	5.10	5.15	5.44	8.85	5.75	5.42 5.18	3.95	4.62	4.06	4.32	4.58	4.66
20 21	5.22 5.22	5.05 5.08	5.42 5.68	6.12	5.70 5.95	4.98	3.88	4.32	4.00	4.32	4.55	4.62
21	7.28	5.35	6.18	6.10	5.80	4.82	3.92	4.28	3.99	4.38	4.52	4.62
3	6.70	5.49	7.22	6.25	5.82	4.78	4.00	4.22	3.96	4.68	4.52	4.6
4	6.20	5.55	8.10	5.15	6.12	4.69	3.97	4.16	3.94	4.55	4.56	4.78
5	6.05	5.50	8.65	5.70	6.58	4.60	3.95	4.18	4.30	4.58	4.50	4.9
86	5.70	5.39	8.70	5.85	7.30	4.50	3.96	4.14	5.05	4.72	4.48	5.12
7	5.35	5.55	7.59	5.72	6.58	4.50	3.96	4.10	7.68	4.84	4.48	5.12
8	5.19	9.48	7.52	5.85	6.12	4.45	4.00	4.05	6.60	5.28	4.42	5.14
29	5.12	0.40	8.42	5.90	6.02	4.46	4.11	4.02	6.22	5.22	4.42	5.14
30	5.08	1	9.05	5.90	6.08	4.38	4.02	4.00	5.92	5.20	4.40	5.7
31	5.18		9.05	0.80	6.12	1.00	3.95	4.00	0.02	4.92	1 - 1	6.7

NOTE.— Ice conditions prevailed January 1 to 21; February 1 to 28; December 3 to 31. Log jam from April 10 to 25.

Daily discharge in second-feet, of Sacandaga River at Wells, N. Y., for 1910.

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	51	470	4.070	4,690	990	2,130	152	54	60	540	292	160
2	51	450	3.750	4,170	945	1.900	155	50	70	440	276	160
3	54	440	2,940	3,110	1.080	1.680	138	54	104	360	292	50
6	55	440	2,290	2,780	1,130	1,600	120	280	253	316	390	50
5	58	450	1,980	2.910	1.080	1,680	113	480	232	268	670	104
6	64	460	1,810	2,780	1,080	2,030	92	260	260	268	656	200
7	66	470	1,860	2,630	1,080	2,390	50	152	219	242	635	232
8	67	480	1.540	2,210	990	1,680	70	120	180	225	588	164
9	67	490	1,420	1.540	990	1,180	62	106	152	232	528	116
10	67	490	1.360	935	836	990	50	104	125	219	492	104
11	66	508	1,260	894	804	1,010	58	390	106	189	450	80
12	69	470	1,100	850	726	1,280	50	280	92	165	430	104
13	69	449	1,010	1,140	684	1,160	48	180	94	195	332	86
14	69	464	900	1,100	684	836	44	135	135	201	292	104
15	69	444	780	670	684	656	41	120	120	189	284	104
16	69	454	656	720	756	570	47	348	106	177	268	116
17	69	433	663	720	684	656	70	308	92	165	268	134
18	93	441	628	1,620	740	726	68	280	81	152	232	134
19	322	414	628	2,710	860	614	60	232	83	145	210	134
20	443	373	614	2,000	820	470	. 52	180	79	145	219	128
21	492	391	804	755	1,040	372	47	145	70	145	210	116
22	2,790	536	1,260	745	900	308	54	135	68	160	201	116
23	1,920	630	2,410	822	918	292	70	120	62	253	201	116
24	1,300	677	3,540	298	1,200	* 256	64	106	58	210	213	164
25	1,140	650	4,310	545	1,680	225	60	110	140	219	195	220
26	820	582	4,380	945	2,510	195	62	101	405	268	189	295
27	570	698	2,870	836	1,680	195	62	92	2,980	316	189	295
28	475	4,850	2,780	945	1,200	180	70	81	1,700	528	171	305
29	440		3,990	990	1,100	183	94	74	1,300	492	171	505
30	420		4,870	990	1,160	160	74	70	1,010	480	165	(305)
31	470	1	4,870	1	1,200	1	. 60	70	1	848	'	(305)

Note.— Daily discharge during the periods of ice conditions based on measurements made under ice cover, climatological reports and on intercomparison of discharge of Sacandaga stations.

Daily discharge during open period based on a fairly well defined rating below 8 feet.

Log jam conditions from April 10 to 25. Special rating table used.

Monthly discharge of	Sacandaga	River at	Wells,	N.	Y., for	1910.
[Drai	nage area,	263 squa	re mile	s.]		

	Dr	т.	Depth of run-off in			
MONTH.	Maximum.	Minimum.	Mean.	Per square mile	inches on drainage area.	Accu-
January February March April May June July August September October November December	4,850 4,870 4,690 2,510 2,390 155 480	51 373 614 298 684 160 41 50 58 145 165	412 646 2,170 1,600 1,014 920 72.8 168 348 266 324 161	1.56 2.45 8.25 6.08 3.95 3.50 .277 .639 1.32 1.01 1.23	1.80 2.55 9.51 6.78 4.55 3.90 .32 .74 1.16 1.37	CCBB A A A A A B C
The year	4,870	41	677	2.57	34.86	

Sacandaga River at Northville, N. Y.

This station is located about ¾ mile upstream from the steel highway bridge at Northville, and was established August 26, 1907 and discontinued November 30, 1910. It has been maintained in co-operation with the U.S. Geological Survey to obtain general statistical and comparative data regarding the flow of the Sacandaga river.

This station is located about 1 mile below the outlet of East Stony creek and about 2 miles below that of West Stony creek. It is about 1½ miles above a low storage dam at Sacandaga park in Northville. Pondage from this dam extends to the highway bridge at certain stages.

A chain gage, attached to a cantilever arm fastened to a tree on the left bank, is read daily. Measurements are made during high water from the steel highway bridge in the village of Northville, medium and low water measurements are made by wading a short distance above the gage.

The datum of the gage has remained the same during the maintenance of the station. The U. S. Weather Bureau maintain a river and flood station at the steel highway bridge. During the winter months the discharge is usually affected by the presence of ice to such an extent that gage readings are discontinued. Conditions for obtaining the accurate discharge for the remainder of the year are very good and an excellent rating curve has been developed.

Information in regard to this station is contained in the annual reports of the U. S. Geological Survey.

APPENDIX E.

Discharge Measurements of Sacandaga River at Northville, N.Y., in 1910.

DATE.	Hydrographer.	Width.	Ar a of section.	Mean velocity.	Gage height.	Dis- charge.
Jan. 11		287 280 280 277 284 282 266	Sq. ft. 188 2,350 1,730 1,900 1,910 968 1,790 1,600 784 143 914	Ft. per sec. 1.36 5.70 4.14 5.04 4.74 1.52 3.69 3.21 .32 2.08 1.43	Pest. *2.35 *7.88 *6.14 *7.14 *6.94 *2.84 *5.90 *1.20 *1.42 *2.74	Secft. (a)255 13,400 7,170 9,570 9,050 1,470 6,610 5,140 247 (b)298 1,310

* Corrected gage heights, 0.74 feet, has been added to conform with original gage datum.

(a) Measurement made about 1,000 feet above gage, under complete ice cover; ice at gage 1.95 feet thick.

(b) Measurement made at wading section.

Daily gage height, in feet,* of Sacandaga River at Northville, N. Y., for 1910. [E. E. Parkes, Jr., observer.]

DAY.	Mar.	April.	Мау.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
		7.61 7.34	4.84	3.62 3.84	1.62	1.70	1.54 1.49	3.74 3.64	2.54 2.59	
		6.13 5.52 6.02	4.18 5.15 5.02	3.64 3.74 3.84	1.54 1.54 1.44	1.74 1.72 1.64	1.72 1.74 1.72	3.02 2.74 3.09	2.52 1.74 1.62	
		5.66 6.14 4.94	4.32 3.82 3.74	5.94 5.25 4.99	1.22 1.23 1.49	1.42 1.44 1.49	1.79 1.74 1.72	2.74 2.49 1.84	1.72 1.74 1.96	
	:	4.44 4.14 3.89	3.42 3.15 3.04	4.74 4.12 4.04	1.26 1.24 1.22	1.64 1.74 2.34	1.64 1.54 1.44	2.74 2.84 2.74	1.94 1.84 1.74	
• • • • • • • • • • • • • • • • • • • •		3.04 2.93 2.83	2.89 2.74 2.82	4.24 3.74 3.24	1.19 1.21 1.16	1.92 1.74 1.84	1.39 1.34 1.42	2.89 2.74 2.76	1.72 1.74 2.16	
••••••	: : : : : :	2.79 2.74 2.83	2.82 2.75 2.52	3.16 3.29 3.42	1.11 1.14 1.19	1.71 1.69 1.64	1.44 1.39 1.54	2.82 2.72 2.69	2.12 2.12 2.22	
••••••	: : : : : :	4.89 6.04 5.84	2.64 2.76 3.02	3.49 3.54 3.02	1.17	1.59 1.69 1.64	1.45 1.32 1.14	2.66 2.62 2.64	2.24 2.29 2.14	
•••••	3 54	4.87 3.89	3.54 3.49	2.74	1.14	1.62 1.54	1.22	2.74 2.94	2.12 2.09	
••••••	. 4.84 . 7.14	3.69 4.94 5.64	3.44 3.14 3.24	2.26 2.09 2.04	1.19 1.21 1.23	1.34 1.34 1.34	1.54 1.55 1.46	3.74 3.71 3.62	2.14 2.12 2.07	
••••••••••••••••••••••••••••••••••••••	6.29	4.12 4.99 5.61	5.69 5.54 4.62	1.99 1.94 1.89	1.19 1.21 1.72	1.40 1.36 1.39	3.54 4.04 4.02	3.64 3.69 3.65	2.09 2.04 2.03	
••••••	. 7.94	4.91	3.64 4.04 3.74	1.76 1.74	1.44 1.26 1.22	1.34	3.81 3.64	3.62 3.24 2.72	1.99 2.04	::::

^{* .74} has been added to make reading conform to original gage datum. Records would seem to indicate that gage heights during June and October are in error.

Daily discharge, in second-feet, of Sacandaga River at Northville, N. Y., for 1910.

DAY.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		11,200	4.390	2,450	360	400	326	2,620	1.090	
2			3.090	2.760	326	412	307	2.480	1.140	
3		7.050	3.280	2,480	326	424	412	1.650	1.070	
4.		5.710	4,960	2.620	326	412	424	1.300	424	
5		6.800	4.720	2,760	291	370	412	1.740	360	
8 	1	6.010	3.500	6,620	223	284	454	1,300	412	
7			2.730	5.160	226	291	424	1.040	424	
B			2,620	4.660	307	307	412	488	578	1
9			2,170	4.210	235	370	370	1,300	562	
0			1.820	3,180	229	424	326	1,420	488	1
1			1.670	3.060	223	901	291	1.300	424	
2			1,480	3.370	214	546	275	1.480	412	1:::::
3		1.530	1.300	2.620	220	424	259	1.300	424	1
4			1,390	1,930	205	488	284	1.330	742	
5			1.390	1.830	191	406	291	1,390	709	:::::
8			1.320	2,000	200	395	275	1.280	709	1
7	: :::: :: ::		1.070	2.170	214	370	326	1.250	794	1:::::
B		4.480	1.190	2,270	208	346	294	1.220	811	1:::::
9		6.840	1.330	2,340	200	395	253	1.170	855	1:::::
0	2,620	6.400	1.650	1.650	197	370	200	1.190	726	1:::::
1		4.450	2.340	1.300	200	360	223	1.300	709	1
2	2.760	2.840	2.270	1,000	205	326	229	1.540	684	
3		2,550	2.200	829	214	259	326	2.620	726	
		4,570	1.800	684	220	259	330	2,570	709	
4 .		5.960	1.930	643	226	259	297	2.450	667	
5		3,180	6.070	602	214	278	2,340	2,480	684	
				562	220				643	
7	. 7,440	4,560	5,750	523	412	266	3,060	2,550		
8	. 7,200	5,900	4,000			275	3,030	2,490	635	
9	. 11,300	4,520	2,480	436	291	259	2,720	2,450	602	
0	. 12,300	(4,460)	3,060	424	235	214	2,480	1,930	643	
1	. 14, 100	1	2,620	1	223	275	1	1,280	1	1

Record for June low. Record for October high, due to errors in gage heights.

Monthly discharge of Sacandaga River at Northville, N. Y., for 1910.
[Drainage area, 740 equare miles.]

	Dı	et.	Depth of			
MONTH.	Maximum.	Minimum.	Mean.	Per square mile.	inches in drainage area.	Accu- racy.
March 20-31	901 3,060	2,340 1,300 1,070 424 191 214 200 488 360	7,470 4,600 2,630 2,240 245 367 722 1,670 662	10.09 6.22 3.55 3.03 .331 .496 .976 2.26 .895	4.50 6.94 4.09 3.38 .38 .57 1.09 2.61	B A C A A C A

Sacandaga River at Upper Bridge near Hadley, N. Y.

This station is located at the steel highway bridge about $2\frac{1}{2}$ miles west of Hadley. It was established September 13, 1907, in co-operation with the U. S. Geological Survey to obtain general and statistical data regarding the flow of the Sacandaga river, which has important storage and power possibilities.

The nearest dam is at Conklingville, about 3½ miles upstream and is partially washed away and not used at present. Occasional log jams occur in the vicinity of this station, causing back water. The discharge is somewhat affected by ice during the winter months.

The datum of the chain gage attached to the bridge has remained the same during the maintenance of the station. Conditions for making accurate discharge measurements are fair, except during the existence of log jams. The rating curve is fairly well developed. Discharge measurements are made from the bridge.

Information in regard to this station is contained in the annual reports of the U. S. Geological Survey.

Discharge measurements of Sacandaga River at Upper Bridge, near Hadley, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section,	Mean velocity.	Gage height.	Dis- charge.
Jan. 21	C. C. Covert	Feet. 207 282 274 286 285 254	Sq. ft. 1,340 1,250 1,190 1,420 1,020 383	Ft. per sec54 8.98 8.20 10.20 7.68 3.45	Feet. 3.92 5.65 5.50 6.15 4.68 2.62	Secft. (a)716 11,200 9,740 14,500 7,840 1,320

⁽a) Measurement made through ice about one mile below second bridge. Average thickness 1.40 feet.

Daily gage height, in feet, of Sacandaga River at Upper Bridge, near Hadley, N. Y., for 1910.

[W. W. Jeffers, observer.]

DAY.	Jan.	Feb.	Mar.	April.	Мау.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
•••••	3.48	5.15	14.3	6.45	4.05	3.72	1.92	1.5	1.3	2.85	2.28	1.9
	3.55	5.25	14.3	6.5	3.98	3.58	1.82	1.55	1.42	2.65		1.9
	3.55	5.45	14.5	6.25	3.8	3.50	1.8	1.58	1.48	2.45	2.12	1.8
	3.55	5.55		5.6	3.82	3.38	1.75	1.6	1.5	2.25	2.35	1.8
	3.6	5.35	5.75	4.9	3.90	3.35	1.7	1.95	1.62	2.15	2.7	1.8
· • • • • • • • • • • • • • • • • • • •	3.6	5.15	5.45	4.55	3.98	3.95	1.62	2.15	1.75	1.98	2.95	1.3
• • • • • • • • • • • • • • • • • • •	8.55	7.3	5.1	4.45	3.85	4.65	1.6	2.3	1.95	1.92	3.08	1.8
• • • • • • • • • • • • • • • • • • •	3.5	7.4	4.85	4.3	3.82	4.58	1.55	2.05	2.0	1.90	3.0	1.
	3.5	7.6	4.7	4.2	3.72	4.60	1.5	1.88	1.88	1.85	2.88	ī.
	3.45	7.75	4.65	4.15	3.55	4.4	1.5	1.8	1.78	1.82	2.8	1.
	3.4	7.85	4.55	3.75	3.32	4.42	1.5	1.75	1.75	1.8	2.68	1.
	3.3	8.0	4.4	3.55	3.28	4.35	1.45	2.05	1.7	1.78	2.6	2.
. 	3.18	8.0	4.25	3.48	3.05	4.4	1.45	1.95	1.62	1.75	2.55	2.
	8.85		4.2	3.4	3.02	4.3	1.4	1.75	1.68	1.78	2.5	2.
• • • • • • • • • • • • • • • • • • •	2.55		4.1	3.25	2.92	4.1	1.4	1.7	1.82	1.75		2.
	2.5		4.0	3.05	2.90	3.75	1.4	1.68	1.78	1.7	2.42	2.
• • • • • • • • • • • • • • • • • • • •	2.5		3.9	2.95	2.8	3.52	1.42	1.62	1.72	1.65	2.38	3
• • • • • • • • • • • • • • • • • • • •	2.55		3.75	8.6	2.85	3.22	1.5	1.65	1.68	1.65	2.28	3.
• • • • • • • • • • • • • • • • • • • •	2.91		3.55	4.2	2.7	3.55	1.48	1.7	1.62	1.6	2.2	8.
• • • • • • • • • • • • • • • • • • • •	3.38	7.2	3.25	4.42	2.78	3.52	1.4	1.75	1.58	1.6	2.15	3.
• • • • • • • • • • • • • • • • • • • •	3.8	7.2	3.05	4.5	2.95	3.38	1.4	1.7	1.52	1.55	2.1	3
	4.45	7.28	3.4	4.35	8.05	3.15	1.42	1.6	1.5	1.58	2.08	3.
	8.0	7.32	3.75	4.15	3.32	2.92	1.42	1.58	1.45	1.7	2.02	3.
	8.35	7.38	4.15	3.95	3.35	2.75	1.4	1.52	1.4	1.78		3.
• • • • • • • • • • • • • • • • • • • •	7.85	7.85	4.5	3.88	3.52	2.48	1.4	1.5	1.5	1.88		8.
• • • • • • • • • • • • • • • • • • • •	7.45	7.25	4.85	3.92	4.15	2.25	1.4	1.45	1.58	1.92	1.98	3.
	6.8	7.15	5.35	4.1	4.50	2.18	1.45	1.4	1.75	1.98	2.0	3.
	6.2	7.6	5.55	4.35	4.28	2.12	1.5	1.4	2.85	2.05	2.05	3.
	5.9		5.75	4.85	4.82	2.05	1.55	1.4	3.2	2.4	2.02	3.
• • • • • • • • • • • • • • • • • • • •	5.5		5.95	4.12	4.05	2.0	1.6	1.85	8.1	2.5	2.0	3.
	5.15		6.15		8.85		1.52	1.82		2.38	0	3.

Ice and log obstruction, January 1 to March 4, inclusive; also December 12 to 31, inclusive

Daily discharge, in second-feet, of Sacandaga River at Upper Bridge near Hadley, N. Y., for 1910

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	300	1,200	22,000	15,000	4,930	3,930	606	340	250	1,830	966
2	300	1,200	20,000	15,200	4,710	3,340	534	370	300	1,490	894
3	300	1,200	15,000	14,000	4,160	3,320	520	388	330	1,190	78
4	300	1,200	12,000	11,100	4,220	3,010	490	400	340	930	1,06
5	300	1,200	11,700	8,050	4,460	2,940	460	630	412	815	1,57
0	300	1,200	10,400	6,660	4,710	4,620	412	815	490	654	2,02
7	300	1,000	8,890	6,290	4,310	7,040	400	990	630	606	2,30
8	300	1,000	7,840	5,760	4,220	6,770	370	715	670	590	2,12
9	300	1,000	7,240	5,420	3,930	6,850	340	576	576	555	1,88
0	300	1,000	7,040	5,260	3,460	6,110	340	520	508	534	1,74
1	300	1,000	6,660	4,020	2,860	6,180	340	490	490	520	1,54
2	300	1,000	6,110	3,460	2,760	5,940	315	715	460	508	1,41
3	300	975	5,590	3,270	2,230	6,110	315	630	412	490	1,34
4	300	975	5,420	3,060	2,160	5,760	290	490	448	508	1.26
5	300	975	5,090	2,690	1,960	5,090	290	460	534	490	1,23
8	300	975	4,770	2,230	1,920	4,020	290	448	508	460	1,15
7	300	975	4,460	2,020	1,740	3,370	300	412	472	430	1.09
8	400	975	4,060	3,590	1.830	3,620	340	430	448	430	96
9	600	975	3,500	5,420	1,570	3,460	330	460	412	400	87
0	700	975	2,690	6,180	1,710	3,370	290	490	388	400	81
1	716	1,000	2,230	6.470	2,020	3,010	290	460	352	370	76
2	7,000	1,100	3,060	5,940	2,230	2,460	300	400	340	388	74
3	10,000	1,200	4,060	5,260	2,860	1,960	300	388	315	460	68
4	6,000	1,300	5,260	4,620	2,940	1,660	290	352	290	508	65
5	4,000	1,400	6,470	4,400	3.370	1,230	290	340	340	576	59
6	3,000	1,500	7,840	4,520	5,260	930	290	315	388	606	65
7	2,000	1,750	9,960	5,090	6,470	848	315	290	490	654	67
8	1,500	15,000	10,800	5,940	5,690	782	340	290	1,830	715	71
	1,500		11,700	5,940	5,830	715	370	290	2,570	1,120	68
0	1,200		12,700	5,160	4,930	670	400	270	2,340	1,260	67
	1,200		13,600		4,310		352	258		1,090	

Back water and ice conditions January 1, to March 4, inclusive. December records not yet available.

Monthly discharge of Sacandaga River at Upper Bridge near Hadley, N. Y., for 1910.

[Drainage area, 1050 square miles.]

	Dr	Depth of				
MONTH.	Maximum.	Minimum.	Means.	Per square mile.	inches on drainage area.	Accu- racy
January Pebruary March April May June July August September October November	10,000 15,000 22,000 15,200 6,470 7,040 606 990 2,570 1,830 2,300	300 975 2,230 2,020 1,570 670 290 258 250 370 590	1,450 1,620 8,330 6,070 3,540 3,640 358 465 611 696 1,130	(1.38) (1.54) (7.93) 5.78 3.37 3.47 .341 .443 .582 .663 1.08	(1.59) (1.60) (9.14) 6.45 3.88 3.87 .39 .51 .65 .76 1.20	дадооооооо о

Sacandaga River Cable Station, near Hadley, N. Y.

This station is located on the Sacandaga river about 1 mile above the mouth of the stream and 6 miles by river, below the proposed dam at Conklingville. It was established November 12, 1910, to obtain data applicable to the proposed storage on this stream.

The river channel at this point was cleared of boulders to make the cross section comparatively smooth and permanent, and a %-inch galvanized wire rope, from which discharge measurements are made, was stretched across the stream.

About 30 feet down stream from the cable and on the left bank, a concrete well was built, 3 feet square, inside dimensions. The bottom of the well is about 2 feet below low water and 12 feet below ground surface; it is connected with the river by a 4-inch cast iron water pipe, 48 feet in length, having its intake end pointing down stream and protected by a fine wire screen. Inside of the well and securely bolted to the side is a bed plank to which is fastened a staff gage with its zero at elevation (573.36) referred to a U. S. Geological Survey aluminum tablet set in the foundation wall of the Union Bag and Paper Company's mill at Hadley. On top of the well is a concrete shelter 6 feet high and 3 feet square, inside dimensions, for protecting the recording gage.

Discharge measurements of Sacandaga River at Cable Station near Hadley, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section	Mean velocity.	Gage height.	Dis- charge.
Oct. 28 Oct. 30 Oct. 31 Nov. 2 Nov. 12	J. J. Phelan J. J. Phelan J. J. Phelan J. J. Phelan J. J. Phelan F. J. Shuttleworth J. J. Phelan	Feet. 215 215 215 213 218 210	Sq. ft. 453 499 457 446 592 399	Ft. per sec. 2.11 2.36 2.26 1.82 2.43 1.58	Feet. 3.80 4.10 3.90 3.70 4.12 3.43	Secft. 948 1,190 1,030 806 1,440 632

Sacandaga River, Union Bag & Paper Company's Mill, Hadley, N. Y.

This station is located at the steel highway bridge near the Union Bag & Paper Company's mills at Hadley, N. Y. It was established in co-operation with the U. S. Geological Survey, September 24, 1909. to obtain general statistical and comparative data in regard to the flow of the Sacandaga and to eliminate discrepancies due to log jams occurring at the Hadley station.

A chain gage is attached to the bridge from which the discharge measurements are made.

No tributaries of any importance enter the river between this station and the one on the second highway bridge near Hadley, N. Y. Gage heights are observed twice daily and furnished through the courtesy of the Union Bag & Paper Company. There are times in the year when the gage heights are affected by back water from the Hudson. Conditions for making discharge measurements are good, and such measurements have been used in connection with those taken at the Hadley station to develop a fairly good rating curve.

Discharge measurements of Sacandaga River at U. B. and P. Co. Mill near Hadley, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
Mar. 1. Cc Mar. 20. Cc May. 20		Feet. 98 130 130 131 126 97 103 108 91 90 90 121 118 120 116 116 116 116 111 101 101 101 101 10	\$q. ft. 563 1,100 1,230 1,230 841 443 554 552 428 428 428 687 633 650 604 576 556 540 527 520 491 490 487 470 480	Ft. per sec. 1.36 6.54 6.90 8.30 0.68 1.51 0.68 0.60 0.74 2.67 2.65 2.20 1.70 1.60 1.39 1.19 1.19 1.19 1.24 1.11 1.11 1.07 0.99	Feet. 5.60 9.85 9.90 10.7 7.88 4.50 4.46 5.87 4.65 4.50 4.46 6.00 5.80 5.20 5.12 5.11 5.02 5.00 4.90 4.80 4.90 4.80 4.80	Secft. (a) 765 (b) 7, -90 8, 490 10, 200 3, 040 328 325 350 350 (c) 262 (c) 262 (d) 264 (d) 264 (d) 265 (d) 264 (d)

⁽a) Section practically open at gage, but ice obstruction below.
(b) Some back water affect from the Hudson River.
(c) Current very creatic and swirly.

West Branch of Sacandaga River at Whitehouse, N. Y.

The West Branch is formed by Piseco Lake outlet uniting with a small stream formed in Silver Lake mountain.

The drainage area is principally bold forest country and is about 188 square miles in extent above Whitehouse where the gaging station is established. The West Branch discharges into the main river about 7 miles west of Whitehouse and about 1 mile south of Wells.

This station was established August 20, 1910, in co-operation with the U. S. Geological Survey, to obtain general statistical and comparative data regarding the flow of the West Branch.

Not enough measurements have been made to determine a rating for this station.

Discharge measurements of West Branch, Sacandaga River, at Whitehouse, N. Y., in 1910.

DATE.	Hydrographer	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
July 16 Aug. 20	J. J. Phelan	Feet. 126 124]		Ft. per sec. 0.58 .80	Feet. 3.32 3.50	Secft. (a)76.4 (a)125

⁽a) Measurements made at wading section.

Daily gage heights of West Branch of Sacandaga River at Whitehouse, N. Y., for 1910.
[John Seaver, observer.]

DAY.	Aug.	Sept.	Oct.	Nov.	Dec.	DAY.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.30 3.30 3.30 3.30 3.38 3.30 3.65 3.65 3.65 3.40 3.40 3.40 3.30	3.95 3.8 3.7 3.68 3.7 3.7 3.7 3.5 3.5 3.4 3.4 3.4	4.1 4.2 4.1 4.02 3.98 4.0 4.0 4.0 3.98 3.9	8.4 3.4 3.3 3.4 3.4 3.3 3.4 3.5 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8	17	3.50 8.50 3.42 3.40 8.40 3.40	3.30 3.30 3.30 3.30 3.30 3.30 3.30 3.40 4.05 4.30 4.15 4.30	3.4 3.4 3.4 3.4 3.4 3.4 3.4 3.4	3.85 3.8 3.75 3.8 3.8 3.7 3.5 3.4 3.4 3.7	3.95 4.0 4.0 4.0 4.0 4.0 4.3 4.3 4.3 4.3 5.0

CATTABAUGUS CREEK DRAINAGE BASIN. Description.

Cattaraugus creek rises in the southwestern part of Wyoming county and flows in a westerly direction, entering Lake Erie about 25 miles southwest of Buffalo, on the boundary line between Erie and Chautauqua counties. The stream is about 55 miles in length and drains an area of approximately 560° square miles above the mouth. A large portion of its course forms the boundary between Erie and Chautauqua counties. Its head waters rise at an elevation of between 1,900 to 2,000 feet. The drainage basin is hilly, fairly well timbered and rather narrow. There are few tributary streams, those of most importance entering the river from the south.

South branch of Cattaraugus creek, which is the largest tributary, enters at a point about 2 miles above Gowanda. There is a dam at Gowanda which is used for developing electric power and also for running a local grist mill and foundry. Formerly there was a development at Versailles, but a flood a few years ago washed the dam out and at present the developments at Gowanda are practically the only ones on the stream.

The average rain fall on the drainage basin is approximately 40 inches. A gaging station was established on this stream at Versailles, September 23, 1910.

Cattaraugus Creek, at Versailles, N. Y.

This station is located at the highway bridge in the village of Versailles, about 8 miles above the mouth of the stream, 6 miles below Gowanda and 3 miles from Lawton Station on the Eric railroad. It was established September 23, 1910, in co-operation with the U. S. Geological Survey, to obtain information regarding the flow of Cattaraugus creek, the principal tributary to Lake Eric from New York.

[•] From Fifth Annual Report of the State Water Supply Commission.

A standard chain gage, reading from 2 feet to 21.5 feet is located on the upstream side of the bridge over the right hand channel. The bridge consists of 3 spans of 117 feet each. Measurements are made from the down stream side of the bridge. Discharge measurements and gage heights only are published.

Discharge measurements of Cattaraugus Creek, at Versailles, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean. velocity.	Gage height.	Dis- charge.
Aug. 24 Sept. 23	C. C. Covert	Feet. 118 130	8q. ft. 167 185	Ft. per sec. 0.886 .741	Feet. 5.02 5.00	Secft. 148 137

Daily gage heights, in feet, of Cattaraugus Creek at Vereailles, N. Y., for 1910.
[James A. Palmer, observer.]

DAY.	Sept.	Oct.	Nov.	Dec.	DAY.	Sept.	Oct.	Nov.	Dec.
1		5.05	6.45	6.45	16		5.08	6.18	5.48
3		4.95	6.55	6.42	17		5.02 5.05	6.10 6.02	5.60 5.60
4		5.05	5.78	5.95	19		5.02	5.98	5.82
5		5.01 5.20	5.60 5.60	5.90 5.68	20		5.02	5.90 5.82	5.80
6		6.15	5.70	5.70	21		5.00 5.62	5.80	5.72 5.62
8		5.55	5.72	5.65	23	5.05	5.75	5.85	5.70
9		5.28	5.78	5.60	24	5.01	5.40	6.68	5.73
10 11		5.22 5.18	7.68	5.72 5.70	25	5.09 5.05	5.48 5.85	6.95 6.55	5.7
l 2		5.12	6.48	5.64	27	5.05	5.55	6.22	5.70
13		5.08	6.30	5.55	28	5.05	6.38	6.20	5.70
14 15		5.08 5.08	6.25	5.65 5.60	29 30	5.05 5.05	6.30	6.68	6.98
	1	00		1.00	31		6.10		6.4

GENESEE RIVER DRAINAGE BASIN. Description.

Genesee river rises in Potter county, Pa., 8 or 10 miles south of the New York-Pennsylvania boundary, flows northwestward for about 32 miles by general course, then turns to the northeast, and empties into Lake Ontario, 7 miles north of Rochester. The entire length of the stream, following bends, is about 135 miles, and the drainage area is about 2,450 square miles.

In the 39 miles between Belmont, in central Allegheny county, and Portage, in southwestern Livingston county, the fall of the water-surface is 253 feet, an average of 6.4 feet per mile. At Portage the river plunges down in three magnificent falls, and thence nearly to Mount Morris flows at the bottom of a deep gorge. From Mount Morris to Rochester the valley is broad and open and the stream is bordered by meadows subject to occasional overflow. At Rochester there is another abrupt descent over three heavy falls, amounting to about 260 feet within the city.

In the northern counties the surface is rolling, with long, easy slopes, except along the streams, which usually lie in deep ravines, hemmed in by steep banks. On the whole there is a gradual rise away from the lakes, and in the upper half of the basin the country becomes rough and is broken by ridges, the summits of which attain elevations of from 2,000 to 2,500 feet above tide.

Precipitation is rather high, the average rainfall being about 35 inches, some 14 inches smaller than that of the upper Sacandaga. Possibilities for storage are great and the State Water Supply Commission of New York proposes a high concrete dam, in the vicinity of Portage, which will store about 18,000,000,000 cubic feet of water, 11,000,000,000 cubic feet of which will be available for commercial purposes. This dam would have a water surface of about 13½ square miles. Such a reservoir would control a flow equal to the greatest recorded, that of 1865. In addition to this high degree of river control the reservoir could be used to develop electric horsepower at Portage to the extent of 75,000 horsepower, peak load, and at the same time allow the mills at Rochester to run the entire year.

Genesee River at St. Helena, N. Y.

This station is located at the steel highway bridge, about 6 miles by river below Genesee lower falls, 4 miles from Castile, and 5½ miles from Portageville. It was established August 14, 1908, in co-operation with the U. S. Geological Survey to obtain general statistical and comparative data regarding the Genesee, which has important storage and power possibilities.

The bed of the stream at this point is of coarse gravel with few rocks and is fairly permanent.

The datum of the chain gage attached to the bridge has remained the same during the maintenance of the station. Two gage readings are made per day. Discharge measurements are made from the highway bridge or by wading.

There has recently been constructed at this station a concrete well and shelter which contain a self-recording gage. The gage house is located on the down-stream side, left-hand end of the bridge. A 4-inch cast-iron water pipe leads to a point in the river channel near the present chain gage, so that the records will be comparable with all previous data.

Information in regard to this station is contained in annual reports of the U.S. Geological Survey.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
April 21 July 19 Aug. 26 Oct. 24 Nov. 17 Dec. 9	C. C. Covert. W. G. Hoyt W. G. Hoyt	102 133	Sq. ft. 889 203 168 150 392 298	Ft. per sec. 3.80 1.11 .946 1.43 2.58 2.16	Feet. 4.92 2.06 1.92 2.14 3.24 2.85	Secft. 3,380 226 159 a214 1,010 b645

Discharge measurements of Genesee River at St. Helena, N. Y., in 1910.

a Measurement made at wading section above bridge.

b Measurement made under partial ice cover; slush ice running in considerable amounts.

Daily gage height in feet, of Genesse River, at St. Helena, N. Y, for 1910.
[Herman Piper, observer.]

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept	Oct.	Nov.	De
1	2.28	2.85	9.27	3.31	4.90	2.85	2.01	1.78	1.85	2.12	2.58	3.55
2	2.25	2.72	8.82	3.14	6.80	2.78	1.88	1.90	2.12	2.02	2.50	3.55
3	2.60	2.95	8.22	2.98	6.65	2.81	1.68	1.88	2.12	1.95	2.45	3.42
4	2.85	2.72	7.22	3.11	6.75	2.71	1.73	1.82	2.15	2.08	2.60	3.38
5	2.68	2.78	6.77	3.08	5.35	2.75	1.95	1.82	2.08	1.98	2.30	3.30
<u>6</u>	2.88	2.65	7.12	2.98	4.72	2.73	1.95	1.78	2.52	2.02	2.20	3.08
7	2.95	2.60	9.42	2.88	4.25	2.73	1.75	1.55	2.85	2.25	2.32	2.98
8	2.92 2.82	2.78	6.27 5.52	2.78 2.84	3.95 3.78	2.68	1.75	1.55 1.80	2.70 2.42	2.38 2.25	2.30	2.90 2.82
9	2.98	2.68	4.85	2.74	3.68	2.65 2.61	1.91 1.91	1.95	2.28	2.18	3.00	2.82
11	2.88	2.62	4.62	2.71	3.50	2.61	1.91	2.15	2.12	2.15	3.95	2.92
12	2.78	2.45	4.55	2.58	3.35	2.65	1.85	2.02	2.05	2.02	3.48	2.85
13	2.75	4.25	4.82	2.54	3.22	2.55	2.25	1.70	2.15	1.60	3.50	2.68
14	2.72	4.05	4.29	2.48	3.08	2.45	2.83	1.70	2.12	1.75	3.22	2.72
15	2.85	3.92	4.02	2.51	2.98	2.35	2.48	1.90	1.95	2.00	3.32	2.65
16	2.72	3.89	3.92	2.54	2.88	2.51	2.28	1.95	2.08	1.75	3.25	2.58
17	2.75	4.47	3.77	2.64	2.88	2.55	2.25	1.62	1.92	1.95	3.28	2.65
18	3.10	4.07	3.57	3.44	2.78	2.45	2.15	1.72	1.65	1.95	3.15	2.68
19	4.40	3.77	3.75	4.36	2.85	2.41	2.04	2.05	1.92	1.88	3.10	2.78
20	4.25	3.59	5.56	4.76	2.68	2.35	2.45	2.02	1.92	1.95	3.00	2.78
21 22	4.20 6.88	3.62	5.71 5.18	4.83	2.75 2.62	2.31	1.80	1.70	1.88	2.10 1.88	2.82	2.48
23	5.45	3.82	5.31	3.90	2.65	2.25	1.72	1.80	1.75	1.82	2.92	2.58
24	4.70	3.52	5.24	6.60	2.88	2.15	1.65	1.88	1.85	2.10	3.00	2.5
25	4.45	6.42	5.31	8.40	2.92	2.03	2.00	1.58	1.95	2.05	4.08	2.60
26	3.80	6.85	4.76	9.30	3.08	2.05	2.02	1.92	1.92	2.18	4.08	2.52
27	3.75	6.69	4.28	6.88	2.95	2.11	1.70	1.65	2.75	2.45	3.65	2.58
28	3.48	7.72	3.98	5.45	2.82	2.01	1.88	1.52	2.48	2.48	3.38	2.62
29	3.25		3.81	5.85	2.68	1.98	1.90	1.80	2.35	2.72	3.40	2.78
30	3.12		3.46	6.10	2.78	1.95	1.82	1.68	2.25	2.52	4.10	7.80
31	3.02	1	3 44	1	2.95	1	1.65	1.80	1	2.62	1	5.0

Note.— Back water at gage due to ice conditions, January 1-18, and February 25-28. Ther, was probably no ice effect for the remainder of the year.

Daily discharge in second-feet, of Genesee River at St. Helena, N. Y., for 1910.

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	180	672	19,500	1,070	3,390	672	187	121	140	226	470	1,290
2	180	568	17,000	919	8,340	614	148	154	226	191	420	1,290
3	190	756	14,000	783	7,880	638	98	148	226	169	391	1,170
4	200	568	9,730	894	8,180	560	109	132	239	211	482	1,130
5	200	614	8,250	868	4.360	591	169	132	211	178	308	1,060
<u>6</u> '	200	517	9,380	783	3,030	575	169	121	432	191	260	868
7	200	482	20,300	698	2,210	575	114	73	672	284	319	783
8	200	614	6,740	614	1,780	538	114	73	552	351	308	715
9	200	591	4,750	664	1.560	517	157	126	374	284	319	647
0	200	538	3,290	583	1,440	489	157	169	298	252	800	647
1	200	496	2,840	560	1,240	489	157	239	226	239	1,780	732
2	200	391	2,710	470	1,100	517	140	191	201	191	1,220	672
3	200	2,210	3,230	445	988	451	284	102	239	80	1,240	538
4	200	1,910	2,270	408	868	391	656	102	226	114	988	568
5	200	1,740	1,870	426	783	335	408	154	169	184	1,080	517
6	200	1,700	1,740	445	698	426	298	169	211	114	1,020	470
7	200	2,570	1,540	510	698	451	284	84	160	169	1.040	517
8	400	1,940		1,190	614	391	239	107	91	169	928	538
9	2,450	1,540		2,390	672	368	198	201	160	148	885	614
0	2,210	1,330		3,110	538		391	191	160	169	800	614
1	2,130	1,360		3 250	591	313	126	102	148	218	732	517
2	8,600	1,310		2,800	496	298	107	154	132	148	647	408
3	4,580	1.610		1,710	517	284	107	126	114	132	732	470
4	2,990	1,260		7,720	698	239	91	148	140	218	800	451
5	2,540	1,500		14,900	732	194	184	77	169	201	1.950	482
6	1,580	2,300		19,700	868	201	191	160	160	252	1,950	432
7	1,520	5,400		8,600	758	222	102	91	591	391	1,400	470
8		11,700		4,580	647	187	148	69	408	408	1,130	496
9	1,020		1,590	5,580	538		154	126	335	568	1,150	614
Ю	902		1,200		614		132	98	284	432		12,100
1	817		1,190		758		91	126		496	2,0000	3,700

NOTE.— From January 1-18 the estimates of discharge are based upon a discharge measureme n^t made in December, 1909, and upon general ice conditions.

February 25-28, daily discharge corrected for ice jam.

Monthly discharge of Genesee Riser at St. Helena, N. Y., for 1910. [Drainage area 1030 square miles.]

	Dı	Depth of run-off in				
MONTH.	Maximum.	Minimum.	Mean.	Per square mile.	inches on drainage area.	Accu- racy.
January. February. March April May. June. July August. September October. November. December	11,700 20,300 19,700 8,340 672 656 239	391 1,190 408 496 169 91 69 91 80 260 408	1,170 1,720 5,480 3,100 1,860 107 191 131 256 238 918 1,150	1.14 1.67 5.32 3.01 1.81 .395 .185 .127 .249 .231	1.31 1.74 6.13 3.36 2.09 .44 .21 .15 .28 .27	B A A A A A A A A
The year	20,300	69	1,380	1.35	18.26	

(lenesee River at Jones' Bridge, near Mt. Morris, N. Y.

This station is at the highway bridge known as Jones' bridge, a short distance below the inflow of Canaseraga creek, and is about 5 miles below Mt. Morris. This station was established May 22, 1903, and was discontinued April 30, 1906. It was re-established August 12, 1908, in co-operation with the U. S. Geological Survey to obtain general statistical and comparative data regarding the flow of the Genesee.

The bed of the stream is of clay, and probably subject to change at times. There are two channels at low stages, three at high. The current is good at medium and high stages, but poor during low water conditions.

Discharge measurements are made from a foot bridge erected on the outriggers of the downstream side of the bridge or by wading.

The datum of the chain gage attached to the bridge has remained permanent during the maintenance of the station. Conditions for making discharge measurements are favorable and a fairly good rating table has been developed.

Information in regard to this station is contained in annual reports of the U. S. Geological Survey.

Discharge measurements of Geneses River at Jones' Bridge, near Mt. Morris, in 1910.

DATE.	Hydrographer.	Width	Area of section.	Mean velocity.	Gage height.	Dis- charge.
April 20	C. C. Covert. C. C. Covert. W. G. Hoyt. C. C. Covert. W. G. Hoyt. W. G. Hoyt.	Feet. 153 145 75 48 70 91	Sq. ft. 852 677 205 45.6 193 333	Ft. per sec. 4.34 4.09 1.58 2.26 1.26 2.91	Feet. 9.38 8.70 4.08 3.35 3.96 5.58	Secft. 3,700 2,770 323 (a)103 244 968

(a) Measurement made at wading section.

Daily gage height in feet, of Genesee River at Jones' Bridge near Mt. Morris, N. Y., for 1910.

[Elizabeth Trewer, observer.]

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.45 4.5	8.05 7.7	27.85 27.7	6.20 5.95	12.90 16.10	5.50 5.25	3.65 3.45	3.60 3.65	3.70 3.85	4.00 4.05	4.70 4.60	6.85 6.40
3 4 5	5.0 5.4 5.35	8.2 8.85 7.55	27.4 25.95 24.05	5.75 5.70 5.70	18.15 21.10 15.80	5.20 5.05 5.00	3.45 3.45 3.65	3.65 3.60 3.55	3.90 4.00 4.05	3.90 3.90 3.70	4.50 4.65 4.45	6.10 5.95 6.00
6 7 8	5.3 5.25 5.35	7.45 7.0 6.9	23.2 25.75 23.7	5.65 5.45 5.30	11.75 9.55 8.40	5.05 5.10 5.10	3.55 3.70 3.60	3.55 3.35 3.40	4.75 5.10 4.90	3.90 4.20 4.45	4.25 4.25 4.30	5.25 5.85 5.60
9 10	5.3 5.3 5.3	7.3 7.15 6.85	18.4 17.85 11.25	5.15 5.00 5.15	8.35 7.45 7.05	5.00 4.90 4.80	3.60 3.10 3.50	3.45 3.55 3.85	4.55 4.25 3.95	4.20 4.15 4.10	4.30 4.70 6.60	6.05 6.05 7.70
12 13 14	5.3 5.3 5.3	6.95 6.9 6.8	10.0 9.4 8.75	5.15 5.05 4.90	6.45 6.25 6.05	4.85 4.80 4.60	3.65 3.65 4.75	3.90 3.60 3.70	3.95 4.00 4.00	4.05 4.00 3.95	6.40 5.70 5.70	7.70 (a)7.65 (a)7.40
15 16 17	5.3 5.3 5.25 5.25	6.8 6.7 7.2	8.35 7.8 7.5 7.1	4.80 4.80 4.90	5.75 5.60 5.50 5.35	4.50 4.60 4.55 4.40	4.70 4.45 4.20 4.15	3.45 3.70 3.45 3.30	3.75 4.00 4.00 3.40	3.70 3.25 3.45	5.70 5.70 5.70	(a)7.35 (a)7.10 (a)6.35
18 19 20 21	6.95 9.85 10.95	9.25 9.9 9.7 9.7	7.0 10.45 13.45	5.75 7.80 8.75 9.25	5.20 5.10 5.20	4.40 4.55 4.50	4.10 4.00 3.70	3.75 3.95 3.85	3.90 3.90 3.75	3.85 3.60 3.70 3.55	5.60 5.40 5.40 5.25	
	19.25 19.55 15.75	9.7 9.7 9.7	11.45 11.4 10.7	9.80 8.05 11.20	5.20 5.15 5.20	4.35 4.20 4.10	3.80 3.60 3.30	3.40 3.60 3.55	3.75 3.60 3.50	3.55 3.25 3.60	5.20 5.10 5.05	(a)6.40
25 26 27	12.55 11.15 10.45	9.7 9.5 8.55	10.95 10.25 8.75	22.25 24.65 24.45	5.55 5.65 5.55	3.90 3.80 3.90	3.60	3.55 3.75 3.60	3.20 3.80 3.90	3.90 4.05 4.50	6.85 7.35 6.55	(4,0.10
28 29 30	9.75 8.9 8.5	15.45	7.85 7.15 6.7	18.50 13.40 17.65	5.35 5.15 5.10	3.95 3.95 3.85	3.80 3.60 3.65	3.60 3.20 3.60	4.50 4.25 4.20	4.40 4.60 4.80	6.00 7.25 7.70	(a) 13.0
31	8.25		6.35		5.15		8.10	3.80		4.70		

(a) Gage height to top of ice.

NOTE.— Back water at gage, due to ice conditions January 1-23, January 30, February 28 and December 9-31; also probably slight affect from ice, for brief periods at other times, January to March and December.

Daily discharge, second-feet of Geneses River at Jones' Bridge near Mount Morris, N. Y., for 1910

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	250	1,400	17,800	1,340		960	190	175	205	300	575	1,70
2	250		17,700	1,200		835	138	190	250	318	530	1,450
3	250		17,500		10,100	810	138	190	265	265	490	1,28
4	250		16,300		12,400	735	138	175	300	265	552	1,20
5	250		14,800	1,060	8,200	710	190	162	318	205	470	1,23
6	250		14,100	1,040	4,980	735	162	162	598	265	390	83
7	250		16,200	935		760	205	112	760	370	390	800
8	250		14,500	860	2,660	760	175	125	665	470	410	80
9	250		10,300	785	2 630	710	175	138	510	370	410	800
0	250	800		710 785	2,060 1.820	665	60 150	162 250	390 282	352	575	80
1	250 250	800 800	4,620			620 642	150	265		335	1,560	80 80
2	250	1,600	3,750	785 735	1,480	620	190	175	282 300	318 300	1,450 1,060	70
3	250	2,000	3,330 2,890	665	1,370	530	598	205	300	282	1.060	60
5	250	2,400	2,630	620	1.090	490	575	138	220	205	1.060	60
	250	2,500	2,030	620	1.010	530	470	205	300	90	1.060	60
	250	2,600	2.090	665	960	510	370	138	300	138	1.060	60
	250	2,600	1.850	1.090	885	450	352	109	125	250	1.010	60
0	1.140	2,300	1.790	2,270	810	450	335	220	265	175	910	65
0	2,400	2,100	4.060	2,890	760	510	300	282	265	205	910	65
1	4.000	2,100	6,320	3.220	810	490	205	250	220	162	835	65
2	9.600	2,100	4.760	3,610	810	430	235	125	220	162	810	60
3	5,200	2,100	4.730	2,430	785	370	175	175	175	90	760	50
4	4.900	2.100	4,240	4.590	810	335	100	162	150	175	735	50
5	4,100	2,100	4.420	13.400	985	265	175	162	80	265	1,700	50
6	3,300	2,100		15.300	1.040	235	195	220	235	318	2.000	500
7	2,600	3,200		15,100	985	265	215	175	265	490	1,530	500
8	2,200	3,700		0,400	885	282	235	175	490	450	1.230	600
9	2,100	5,100	1.880	6.280	785	282	175	80	390	530	1.940	70
0	1,900		1,620	9,680	760	250	190	175	370	620	2.210	5.00
1	1,700		1.420	5,000	785	200	60	235	3.0	575		13.00

Note.— Ice conditions which prevailed at this station during January, February and December 6-31, 1910, made it necessary to base discharge for this period upon flow at St. Helena and Rochester and upon climatological reports.

Monthly discharge of Genesee River at Jones' Bridge near Mount Morris, N. Y., for 1910.
[Drainage area, 1,410 square miles.]

	Di	Depth of					
MONTH.	Maximum.	Minimum.	Mean.	Per square mile.	run-off in inches on drainage area.	Accu-	
January February March April May June July August September October November	17,800 15,300 12,400 960 598 282 760	1,420 620 760 235 60 80 80 90 390	1.600 1,760 6,690 3,510 2,630 541 226 178 316 300 989 1,280	1.13 1.25 4.06 2.49 1.86 .384 .160 .126 .224 .213 .701	1.30 1.30 5.72 2.78 2.14 .43 .18 .15 .25 .25	DDCCCCBBBBBBB	
The year	17,800	60	1,700	1.20	16.33		

Genesee River at Elmwood Avenue, Rochester, N. Y.

This station is located at a highway bridge about $3\frac{1}{2}$ miles south of the city of Rochester, at the northern end of South Park.

It was established by the U. S. Geological Survey, February 9, 1904. and has been maintained in co-operation with the Barge canal and the State Water Supply Commission to date.

The bed of the river is composed of gravel and is fairly permanent. The bridge consists of six spans of about 125 feet each. Measurements are made with current meter from the up-stream side of the bridge. Conditions are very favorable for making accurate measurements, although in periods of low water small velocities may affect the accuracy somewhat.

A staff gage is fastened to the down-stream face of the first pier from the right-hand abutment of the bridge. This has been read under the direction of E. A. Fisher, City Engineer. During the summer of 1910 a Gurley recording gage was installed in the pump house located at the right-hand end of the bridge and since that time nearly continuous records have been obtained. The datum for both the staff and recording gages has remained the same, zero of gage 506.848, Barge canal datum.

Discharge measurements of Genesee River at Elmwood avenue, Rochester, N. Y., in 1904-1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
1904		Feet.	Sq. ft.	Pt. per sec.	Feet.	Secft.
July 20	C. C. Covert				1.30	592
Aug. 9	E. A. Fisher				1.18	614
Aug. 10	E. A. Fisher				1.10	589
Aug. 11	E. A. Fisher				1.15	594
Aug. 12	E. A. Fisher				1.20 1.10	667 587
Aug. 15 Aug. 27	E. A. Fisher				1.22	703
Aug. 30	E. A. Fisher				1.08	554
Sept. 17	E. A. Fisher				1.05	511
Nov. 11	C. C. Covert				1.20	534
1905.	0.0.00.00.00.		1		-:	
Mar. 22	Covert & Weeks	382	4.220	5.87	10.0	24.710
Mar. 22	Covert & Weeks	382	4,200	5.92	9.95	24,860
Mar. 25	Covert & Weeks	382	4,300	5.92	10.20	25,490
Mar. 27	Covert & Weeks	382	4,200	6.00	9 92	25,180
Mar. 27	Covert & Weeks	382	4,160	5.94	9.82	24,750
Mar. 28	Covert & Weeks	382	4,050	5.82	9.50	23,550
Mar. 29	Covert & Weeks	382	3,960	5.69	9.08	22,530
April 2	Covert & Weeks	373	2,140	3,06	4.18	6,530
April 3	Covert & Weeks	372	1,890	2.75	3.50	5,197
April 4 May 28	Covert & Weeks	372 352	1,820 974	2.52 .45	3.28 1.11	4,576 441
1906.	C. C. Covert	352	9/4	.40	1.11	221
Feb. 14	Covert & Weeks	306	1,710	0.43	1.40	(a)728
Feb. 15	Covert & Weeks	360	1.020	.88	1.53	(a)894
Mar. 28	Weeks & Casey	383	3.160	4.47	6.85	14,110
Mar. 29	Weeks & Casey	383	3,320	4.55	7.32	15.090
Mar. 30	Weeks & Casey	383	2,680	3.58	5.64	9,580
Mar. 31	Weeks & Casey	383	2,860	4.33	6.06	12,370
Mar. 31	Weeks & Casey	383	2,940	4.54	6.31	13,340
April 1	Weeks & Casey	384	3,040	4.67	6.60	14,190
April 1	Weeks & Carey	383	3,050	4.25	6.36	12,960
April 2	Weeks & Casey	376	2,480	3.56	5.08	8,830
April 2	Weeks & Casey	375	2,330	3.08	4.70	7,160
April 3	Weeks & Casey	374	2,100	2.79	4.10	5,860
1907. Mar. 18	C. C. Covert	383	2.820	3.95	6.02	11.130
May 2	E. C. Niles		1.821	2.26	3.50	4,117
July 26	E. C. Niles		1,074	.738	1.40	793
Aug. 12	E. C. Niles		918	.295	.95	271
Aug. 28	E. C. Niles		903	.271	.90	245
Aug. 28	E. C. Niles		917	.313	.95	287
1908.					1	
July 14	Niles & Patchke		992	.692	1.20	685
Aug. 14	Brett & Adams	341	1,130	1	1.30	670
1909.		l			1	٠
Mar. 15	C. C. Covert	358	1,760	2.28	3.21	4,020
April 21	C. C. Covert	360	1,620	2.35	2.82	3,810
May 11	A. R. Patchke		1,960	3.07	3.88	6,013
1910. Oct. 22	Hoyt & Shuttleworth	338	1.110	.832	1.07	369
Nov. 18	W. G. Hoyt	248	1.380	.96	1.85	1,320
1101. 10	Q. HOye	2.10	1,000		1 2.00	1,000

⁽a) Measurements made_under_ice_conditions.

Daily gage height, in feet, of Genesse Riser at Elmwood asenue, Rochester, N. Y., in 1910.
[G. A. Bailey, observer.](a)

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.00	2.00	6.60	2.20	6.00	1.80	1.10	1.00	.76	1.3	1.2	
2	1.00	2.00	7.20	2.20	5.40	1.80	1.10	1.00	1.00	1.3	1.3	2.3
3	1.00	2.00	9.00	2.00	6.60	1.80	1.10	1.00	1.00	1.3	1.3	
4	1.00	2.00	10.80	1.90	7.50	1.70	1.10	.95	1.00	1.3	1.3	2.0
5	1.00	2.00	11.00	1.90	7.40	1.70	1.10	.95	1.00	1.3	1.3	2.0
6	1.00	2.00	10.40	1.90	5.40	1.80	1.08	.90	1.60	1.4	1.3	1.9
7	1.00	2.00	9.90	1.80	4.00	1.80	1.05	.90	2.20	1.6	1.3	1.8
8	1.00	1.90	9.60	1.80	3.50	1.80	1.02	.90	2.00	1.6	1.3	1.90
9	1.00	1.90	9.30	1.80	3.10	1.80	1.00	.90	1.50	1.5	1.3	2.10
0	1.00	1.80	8.20	1.80	3.00	1.70	1.00	.90	1.50	1.4	1.3	1.70
1	1.00	1.70	5.70	1.70	2.80	1.70	1.00	1.00	1.40	1.4	1.4	1.70
2	1.00	1.70	4.40	1.70	2.50	1.70	1.00	1.00	1.30	1.2	2.3	1.50
3	1.00	1.70	4.00	1.60	2.50	1.70	.98	1.00	1.20	1.2	2.1	1.5
4	1.00	1.70	3.80	1.60	2.30	1.60	1.00	1.00	1.15	1.2	1.9	1.43
5	1.00	1.70	3.50	1.50	2.10	1.60	1.00	.99	1.10	1.2	1.9	1.42
6	1.00	1.70	3.20	1.50	2.00	1.50	1.30	.98	1.20	1.1	1.9	1.49
7	1.00	1.90	3.00	1.50	2.00	1.50	1.30	1.00	1.10	1.1	1.9	1.5
8	1.20	2.40	2.90	1.70	2.00	1.40	1.10	1.00	1.05	1.1	1.9	1.33
9	1.30	3.00	2.70	1.90	1.90	1.40	1.10	1.00	1.00	1.0	1.9	1.24
: 0 .	1.60	3.00	2.70	2.80	1.90	1.40	1.10	1.00	1.02	1.0	1.9	1.32
1	3.60	3.00	5.10	3.50	1.80	1.40	1.10	.98	1.02	1.0	1.8	1.51
22	4.00	3.00	4.80	3.30	1.70	1.30	1.10	.97	1.00	1.0	1.7	1.52
3	5.00	3.00	4.30	3.20	1.60	1.30	1.00	1.00	1.00	1.0	1.6	1.31
4	5.10	3.00	4.20	3.30	1.70	1.30	1.00	1.00	1.00	1.0	1.6	1.24
5	4.00	3.00	4.00	6.80	1.90	1.20	1.10	1.00	1.10	1.1	1.6	1.28
8	3.60	3.00	4.00	7.60	2.00	1.20	1.10	.97	1.10	1.2	2.5	1.35
7	3.20	3.00	3.50	8.20	2.00	1.20	1.10	.95	1.05	1.2	2.6	1.21
8	2.80	3.00	3.00	8.20	2.00	1.10	1.05	.90	1.05	1.2	2.3	1.24
9	2.60		2.70	6.80	1.90	1.10	1.00	.88	1.10	1.2	2.3	1.29
0	2.20	I	2.50	6.50	1.90	1.10	1.00	.86	1.10	1.2	2.8	1.46
1	2.00	I	2.30		1.80	1	1.00	.79		1.2		3.73

⁽a) The gage heights for July, August and September were observed by G. A. Bailey; for December they were taken by a recording gage, and for the rest of the year they were furnished by E. A. Fisher, City Engineer of Rochester.

Daily discharge, in second-feet, of Genesee River, at Elmwood avenue, Rochester, N. Y., for 1910.

DAY	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	320	1,600	13,200	1,960	11,400	1,300	405	320	174	610	500	(2,640)
2	320		15,100		9,620	1,300	405	320	320	610	610	
3	320		21,400		13,200	1,300	405	320	320	610	610	(1,970)
4	320		28,200		16,100	1,150	405	285	320	610	610	1,760
5	320		29,000		15,800	1,150	405	285	320	610	610	1,620
6	320		26,600	1,450	9,620	1,300	388	250	1,000	730	610	1,450
7	320		24,700	1,300	5,800	1,300	362	250	1,960	1,000	610	1,300
8	320		23,600	1,300	4,600	1,300	337	250	1,600	1,000	610	1,450
9	320		22,500	1,300		1,300	320	250	860	860	610	1,780
0	320		18,500	1,300	3,500	1,150	320	250	860	730	610	1,150
1	320		10,500	1,150	3,100	1,150	320	320	730	730	730	1,150
2	320	1,150		1,150	2,500	1,150	320	320	610	500	2,140	860
3	320	1,150	5,800	1,000	2,500	1,150	306	320	500	500	1,780	944
4	320	1,150		1,000	2,140	1,000	320	320	452	500	1,450	769
5	320	1,150	4,600	860	1,780	1,000	320	313	405	500	1,450	756
6	320	1,150	3,940	860	1,600	860	610	306	500	405	1,450	847
7	320	1,450	3,500	860	1,600	860	610	320	405	405	1,450	888
8	500	2,320	3,300	1,150	1,600	730	405	320	362	405	1,450	646
9	610	3,500	2,900	1,450	1,450	730	405	320	320	320	1,450	544
0	1,000	3,500	2,900	3,100	1,450	730	405	320	337	320	1,450	634
1	4,840	3,500	8,780	4,600	1,300	730	405	306	337	320	1,300	874
22	5,800	3,500	7,940	4,160	1,150	610	405	299	320	320	1,150	888
3	8,500	3,500	6,580	3,940	1,000	610	320	320	320	320	1,000	622
4	8,780	3,500	6,320	4,160	1,150	610	320	320	320	320	1,000	544
5	5,800	3,500	5,800	13,900	1,450	500	405	320	405	405	1,000	588
26	4,840	3,500		16,400	1,600	500	405	306	405	500	2,500	670
7	3,940	3,500		18,500	1,600	500	405	285	362	500	2,700	511
8	3,100	3,500		18,500	1,600	405	362	250	362	500	2,140	544
9			2,900	13,900	1,450	405	320	238	405	500	2,140	599
80			2,500	12,900	1,450	405	320	226	405	500	3,100	808
1					1,300		320	186		500		5,150

Norm.— Daily discharge for open channel periods based on a well defined rating. Discharge during the periods of ice conditions based on measurements made under ice cover and the discharge at other Genesse river stations.

Monthly discharge of Genesee River at Elmwood avenue, Rochester. N. Y., for 1910.
[Drainage area 2,360 square miles.]

	Dı	SCHARGE IN	SECOND-FEI	ir.	Depth of run-off in	
Month.	Maximum.	Minimum.	Mean.	Per square mile.	inches on drainage area.	Accu- racy.
January February Maroh April May June July August September October November December	3,500 29,000 18,500 16,100 1,300 610 320	320 1,150 2,140 860 1,000 405 320 186 174 320 500 511	1,920 2,180 10,600 4,620 4,130 906 379 291 533 537 1,290 1,160	.814 .924 4.49 1.96 1.75 .384 .161 .123 .226 .228 .547 .492	.94 .96 5.18 2.19 2.02 .43 .19 .14 .25 .26	BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB
The year	29,000	174	2,390	1.01	13.74	

CANASERAGA CREEK DRAINAGE BASIN. Description.

Canaseraga creek, one of the most important tributaries to the Genesee river from the East, rises in the extreme northwestern corner of Steuben county and flows in a northwestern direction to its junction with the Genesee river, a short distance below the village of Mt. Morris.

Through its entire course, the creek flows through a flat, fertile valley, devoted almost entirely to the pursuit of agriculture. From the village of Dansville to Mt. Morris, a distance of 22½ miles, the river winds back and forth across the valley. The velocity is so slow that the large amount of silt which is brought down from the foot hills by the smaller streams is deposited in the creek bed, raising it to an elevation higher, in many cases, than the surrounding country. The deposit of silt coupled with the extreme deviation of the creek from a straight line, causes the 11,000 acres, which border on the stream, below Dansville to become annually inundated by the flood waters. The State Water Supply Commission, acting upon the petition of the people residing in the vicinity, and under the authority acquired in 1906 when the duties of the River Improvement Commission were transferred to them, have sold bonds to the extent of \$200,000 and work is now being started which is expected to alleviate much of the damage caused by flooding.

Canaseraga Creek at Dansville, N. Y.

This station is located at the highway bridge one mile due west from the village of Dansville and about 22 miles above the mouth of the stream.

It was established July 21, 1910, in co-operation with the U. S. Geological Survey to obtain data in regard to the flow of this stream and to aid in a general way the studies being made of the flow of the Genesee river.

A staff gage is bolted to the down-stream, left-hand wing wall and is read twice daily. Low water measurements are made by wading below the bridge and high water measurements will be made from the bridge. The bed of the stream at this point is composed of sand and gravel and may shift during high water.

The rating curve is not yet sufficiently developed to warrant publishing the discharge so only discharge measurements and gage heights are published.

Discharge measurements of Canaseraga Creek at Dansville, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
July 21 Aug. 21 Oct. 26	W. G. Hoyt. C. C. Covert. F. J. Shuttleworth.	Feet. 42 43 44	Sq. ft. 22.7 29.6 22.6	Pt. per sec. 1.25 1.22 1.36	Feet. 1.75 1.72 1.80	Secft. (a)27 3 (a)36 0 (a)39.7

⁽a) Measurement made at wading section.

Daily gage height in feet of Canaseraga Creek at Danetille, N. Y., for 1910.

[Floyd Harter, observer.]

DAY.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	DAY.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1		1.75 1.78 1.75 1.75 1.75 1.75 1.75 1.92 1.82	1.75 1.88 1.80 1.75 1.78 1.75 1.75 1.72 1.72 1.72	1.70 1.68 1.68 1.75 1.75 1.75 1.75 1.75 1.72 1.70 1.70	1.75 1.80 1.80 1.78 1.78 1.90 2.02 2.15 1.92 1.80 1.82 1.80	1.98 2.08 2.02 2.00 1.92 1.90 1.82 1.88 1.85	18 19 21 22 23 24 25 26 27 28 29	1.75 1.75 1.75 1.75 1.75 1.75 1.75 1.75	1.78 1.85 1.75 1.75 1.75 1.70 1.72 1.82 1.75 1.75 1.75	1.78 1.75 1.72 1.72 1.72 1.85 1.78 1.75 1.75	1.72 1.68 1.68 1.72 1.75 1.75 1.88 1.82 1.82 1.80	1.82 1.92 1.88 1.82 1.80 1.85 1.80 2.08 2.02 1.95 2.05	

Note.—Ice conditions prevailed December 10-31. No gage heights for this period.

Canascraga Creek at Shakers' Crossing, N. Y.

Measurements have been made from the highway bridge at Shakers' Crossing, about one-half mile above the junction of Canaseraga creek with Genesee river.

Owing to the fact that during any flood period the water is backed up from the Genesee river, no gage has been installed at this place, but measurements have been referred to a reference point and are here published under one head.

The reference point to which these measurments have been referred is the top of the horizontal tie bar 20 feet from the left-hand abutment, downstream side of bridge.

Discharge measurements of Canaseraga Creek at Shakers' Crossing, near Mt. Morris, N.Y., 1904-1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
1904. April 12 July 16 1905.	R. E. Horton		Sq. ft.	Pt. per sec.	Feel. 7.58 3.8	Secft. 1,050 242
Mar. 24	C. C. Covert.	100 100 90 82 60	1,450 772 546 374 92	1.47 3.72 3.87 3.86 2.73	18.88 12.32 9.88 7.88 3.72	(b)2,010 2,880 2,120 1,440 252
Mar. 29	C. C. Covert. C. C. Covert. C. C. Covert	84 94	500 456 900 368 310 142	3.76 3.55 1.86 3.89 3.71 3.37	9 22 8 90 13 55 7 85 7 00 4 45	1,880 1,620 (b)1,670 1,430 1,150 478
1910. April 20 July 20 Aug. 22 Oct. 26	C. C. Covert W. G. Hoyt C. C. Covert F. J. Shuttleworth	86 66 34 63	278 126 16.9 135		6.29 3.90 2.52 3.84	594 270 (c) 36 . 6 260

⁽a) Gage datum is 25 feet below reference point on horizontal tie-bar 20 feet from left hand end down stream side of bridge.

(b) Back water from Genesee river.

(c) Made by wading below bridge.

KESHEQUA CBEEK DRAINAGE BASIN.

Description.

Keshequa creek, the principal tributary to Canaseraga creek, has its source among the hills of northern Allegheny county and flows north and northeast through Nunda and Tuscarora joining Canaseraga creek near Sonyea, the home of the Craig Colony for epileptics. Throughout its length of some 20 miles it flows through a narrow valley and falls about 1,200 feet. No power is developed as the flow during the summer averages only 3 to 6 second-feet. The yearly rain fall is a little above the average for the Genesee Valley and ranges from 28 to 36 inches.

Keshequa Crcek at Sonyea, N. Y.

This station is located at the upper highway bridge in the village and about two miles above the mouth of the stream. It was installed to aid in the studies of the flow of Canaseraga creek and to obtain data in regard to the run-off of small drainage areas in the western part of the State.

A staff gage was installed July 22, 1910, in co-operation with the U. S. Geological Survey. This gage is fastened to a pile, located on the right-hand bank between the two bridges, directly back and across from the Craig Colony power house. This gage is intended only for the low-water periods of the year as on October 25, a chain gage was installed on the up-stream side of the upper bridge. Discharge measurements are made by wading. Either bridge may be used during high water.

The bed of the creek is composed of gravel and sand and the channel shifts back and forth from year to year. The rating curve is not developed as yet and only gage heights and discharge measurements are published.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.*	Die- charge.
1910. July 22 Aug. 26 Oct. 25	W. C. Hoyt. C. C. Covert. W. C. Hoyt.	Feet. 18 8.6 22	Sq. ft. 6.16 2.6 8.6	Ft. per sec. .424 .75 .58	Feet. 0.55 0.52 (b)0.61	Secft. (a)2.51 (a)1.96 (a)4.99

Daily gage height in feet, of Keehegus Creek at Sonyea, N. Y., for 1910. [Elmer E. Reynolds, observer.]

DAY.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	DAY.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		.55 .62 .58 .55 .55 .55 .55 .58 .62 .72 .65 .58 .55	.65 .65 .65 .68 .68 .68 .68 .60 .60 .60	.55 .55 .55 .55 .55 .62 .80 .75 .68 .65 .65 .65	.65 .65 .70 .68 .65 .65 .70 .80 .80 .80 .78	.95 .85 .80 .75 .80 .80 .80	17	.55 .58 .55 .55 .55 .55 .55	.60 62 .75 .70 .62 .60 .60 .58 .65 .60	.60 .60 .62 .65 .65 .65 .60 .60 .60 .55	. 55 . 55 . 55 . 55 . 58 . 60 . 60 . 60 . 60 . 65 . 65 . 65	.75 .75 .76 .70 .75 .70 .70 .82 .82 .80 .88 .88	

Note. - Readings discontinued December 9 on account of ice conditions.

SALMON RIVER DRAINAGE BASIN.

Description.

Salmon River rises in the southwestern part of Lewis county, N. Y. and flows southward and then northward, entering Lake Ontario near Port Ontario. Its drainage area comprises about 285 square miles. The topography is generally rolling in character, and the soil is sandy, rock lying near . the surface in the upper part of the basin, where there are extensive tracts of virgin forest.

The mean annual precipitation is about 35 inches, and during the winter there is usually a heavy fall of snow, which often accumulates in the forest areas to a depth of several feet. The gradual melting of this snow, in the spring, tends to prevent high freshets.

The basin affords several opportunities for storage. At High Falls there is an undeveloped fall of about 110 feet, occurring in a very short distance. Considering its size, this river has rather important power possibilities.

A gaging station has been maintained in this river basin near Pulaski from 1900 to 1908 and 1910.

^{*} Staff gage.

(a) Measurement made at wading section.

(b) Chain gage read 3.46.

Salmon River at Fox's Bridge, near Pulaski, N. Y.

This station is located on the first highway bridge above the village of Pulaski and was established by the U. S. Geological Survey, September 5, 1900. A vertical staff gage was attached to the up-stream end of the center pier, with its zero 11.59 feet below the bench mark, which is the top of the cap stone of the center pier.

This gage was removed by ice during the winter of 1901-1902 and then replaced July 23, 1902, by a chain gage, having its zero 12.79 feet below the original bench mark. The station was discontinued June 30, 1907, reestablished August 16, 1908, and discontinued December 6, 1908. It was maintained during these periods in co-operation with the State Engineer and Surveyor of the State of New York.

On July 14, 1910, it was re-established by the survey in co-operation with the State Water Supply Commission of New York, for the purpose of obtaining general statistical data regarding the flow of Salmon river. The gage datum has remained permanent since July 23, 1902. Discharge measurements are made from the bridge or by wading.

The station can be reached by a short drive from either Pulaski or Richland. Conditions are poor for records during the winter, when the channel usually becomes clogged by ice. The open channel rating is fairly good.

Information regarding this station is contained in the reports of the State Engineer and Surveyor, State of New York, and in the annual reports of the U. S. Geological Survey.

Discharge measurements of Salmon River at Fox's Bridge near Pulaski, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
July 13 Aug. 25	W. G. Hoyt	Feet. 168 169	Sq. ft. 239 234	Ft. per sec. 704 774	Feet. 2.61 2.61	Secft. 168 (a)181

(a) Measurement made at wading section.

Daily gage height in feet, of Salmon River at Fox's Bridge, near Pulaski, N. Y., for 1910.
[Seynour J. Fox, observer.]

DAY.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	DAY.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
14		2.50 2.50 2.58 2.58 3.50 3.15 2.90 2.92 8.85 3.62 3.35 2.87 2.87 2.87	3.60 3.12 3.75 3.50 3.70 3.72 3.25 3.05 2.70 2.78 2.60 2.62 2.70	2.58 2.50 2.48 2.92 4.05 4.10 3.65	3.10 3.70 3.55 3.50 3.42 3.50 3.38 3.65 4.80 4.30 4.30 4.75 8.60	3.18 3.10 3.02 2.90 2.90 2.90 3.00 3.00 3.00 3.10 3.05	17 18 19 20 21 22 28 24 25 26 27 28 29 30 31	2.72 2.70 2.50 2.48 2.52 2.50 2.65 2.55 2.55 2.50 2.60 2.50 2.60	2.80 3.28 3.38 2.98 2.72 2.75 2.60 2.75 2.90 2.82 2.62 2.50	2.50 2.50 2.50 2.55 2.45 2.65 2.65 2.68 2.68	2.62 2.60 2.60 2.55 2.55 2.55 2.98 3.75 3.58 3.52 3.52 3.52 3.52 3.88 3.22	3.35 3.28 3.25 3.10 3.30 3.28 3.50 3.48 3.30 3.28 3.28	

Daily disch						

DAY.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	DAY.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1 2 3 4 5 5 6 7 7 8 9 10 11 12 13 14 15 16		140 140 188 172 305 700 1,070 450 315 325 1,020 798 582 290 229 188	920 700 870 890 512	172 140 133 325 1,240 1,300 825 480 432 365 1,050 256	420 870 740 700 636 700 605 605 825 2,420 1,570	376 315 315 315 365 365 365	22 23 24 25	229 220 140 133 148 140 188 200 160 160 140 180	290 265 532 605 355 229 242 180 242 315 275 188 140 200	140 140 180 140 160 122 140 200	180 160 160 212 365 355 920 764 716 716	582 532 512 420 545 532 582 700 684 605	

NOTE.—Ice conditions prevailed December 17-31.

Monthly discharge of Salmon River at Fox's Bridge near Pulaski, N. Y., for 1910.
[Drainage area, 264 square miles.]

	Dr	Depth of				
MONTH.	Maximum.	Minimum.	Mean.	Per square mile.	inches on drainage area.	Accu- racy.
July 14-31 August September October November December 1-16	1.0/0	133 140 122 133 420 315	173 360 340 443 736 382	.655 1.36 1.29 1.68 2.79 1.45	.44 1.57 1.44 1.94 3.11 .86	B B B B

BLACK RIVER DRAINAGE BASIN. Description.

Black river rises in the western part of Hamilton county, N. Y., flows southwestward across Herkimer county into Oneida county, turns near Forest-port and runs somewhat west of north through Lewis county to eastern Jefferson county, and then flows westward to Black River bay, at the eastern extremity of Lake Ontario. Its total drainage area is 1,930 square miles. The upper part of the basin is very rugged and mountainous, contains a large number of lakes, and is in a part of the Adirondack forest.

The mean annual precipitation is about 40 inches, ranging from 55 inches in the extreme headwaters to perhaps 30 inches near Lake Erie. The winters are generally quite severe, and the stream flow is affected by ice for periods of several months.

The regimen of the river is controlled by storage on its upper tributaries (including Beaver river at Beaver), a series of reservoirs at the headwaters of Moose river, and additional reservoirs at Forestport and on the headwaters of the main river.

Water is diverted from Black river through Forestport feeder to supply the Black River canal at Boonville. A portion of this diverted water flows northward from Boonville and enters Black river again at Lyons Falls; the remainder flows southward through the Black River canal and enters the Erie canal at Rome.

A discharge measurement of Black river was made by C. C. Covert September 23, 1910, at a point 1,000 feet above the first highway bridge below Hawkinsville and about two miles northwest of Boonville. Discharge 80.7 second-feet. This does not include the division through Forestport feeder to Black River canal.

Moose River at Moose River, N. Y.

This station is located in the village of Moose River, about three miles down-stream from the McKeever station on the Adirondack division of the N. Y. C. R. R. It was established June 5, 1900, to obtain general statistical data regarding the flow.

At McKeever is a timber dam used for power and water regulation for log-driving purposes so that during portions of the year two gage readings a day may not give a good mean. From the dam down to the station the velocity is relatively slow but below the station it is very high. Just above the station is a small island upon which ice and log jams occasionally form.

At the station the bed of the river is cobble, with occasional large boulders, the current is smooth, and the depth fairly uniform. The stream freezes over in winter, alternate layers of ice and snow forming in such a way as to render the computations of discharge during the frozen period of the year impossible.

In July, 1903, a cable having a clear span of 269 feet was erected and since that time current meter measurements have been made from this. A staff gage divided into two parts is located on the left bank a short distance above the cable. The elevation of the gage zero was changed on February 28, 1903, from 15.36 to 15.53. A fairly accurate rating curve has been developed for the open water channel.

Information regarding this station may be found in the annual reports of the Engineer and Surveyor, State of New York, and in the annual reports of the U. S. Geological Survey.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
May 12	W. G. Hoyt	Feet. 218 204	Sq. ft. 768 413	Ft. per sec. 1.12 .63	Peet. 2.51 .88	Secft. 862 260

Discharge measurements of Moose River at Moose River, N. Y., in 1910.

Daily gage height, in feet, of Moose River at Moose River, N. Y., for 1910.
[Chris. Hannan, observer.]

=								===	====	===	==
DAY.	Jan.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1	1.10 1.00 1.00 1.25 1.35 1.55 1.70	7.10 6.50 5.65 5.10 4.80 4.80 4.80 4.65 4.50 4.35 4.35 4.30 4.35		4.30 4.20 4.20 4.35 4.05 3.75 3.40 3.10 2.80 2.45 2.10 1.60	2.40 2.90 3.25 2.90 3.20 3.55 3.70 3.55 3.25 3.25 3.20 2.90 2.40 2.20 2.00	.90 .95 .95 1.00 1.10 1.20 1.10 .95 .90 .80 .80 .80	.95 .95 .95 2.40 4.10 3.20 2.95 2.30 2.45 3.30 2.45 3.10 2.70 2.60 2.35	.85 .80 .70 .80 .90 1.40 1.35 1.30 1.45 1.45 1.45	3.10 2.85 2.80 2.70 2.55 2.40 2.25 2.00 1.90 1.60 1.60	2.50 2.50 2.60 2.65 2.65 2.65 2.35 2.30 2.20 2.10 2.00 1.75	1.30 1.20 1.35 1.70 1.45 1.70 1.60 1.35 .95 .80 .70 .80 .80
17 18 19 20 21 22 23 24 25 26 27 28 29 30 31		3.30 3.10 2.85 2.60 2.85 3.30 4.05 6.35 6.35 6.35 6.35 6.35	2.60 2.50 2.50 2.40 2.40 2.40 3.10 3.85 3.80 3.95 4.25	1.65 2.00 2.30 2.45 2.70 3.00 3.25 2.95 2.90 2.80 2.70 2.55 2.20	2.00 1.90 1.80 1.70 1.60 1.50 1.30 1.15 1.10 1.05	.80 .90 .80 .70 .70 .90 .95 .90 .75 .90	2.35 2.15 2.00 1.95 1.80 1.65 1.45 1.20 .95 .75 .55 .00 .95	1.40 1.25 1.20 1.30 1.40 1.50 1.65 1.95 2.40 3.05	1.60 1.70 1.80 1.95 2.00 2.15 2.35 2.35 2.30 2.20 2.35	1.73 1.70 1.50 1.50 1.50 1.50 1.50 1.40 1.40 1.40	.80 .70 .80 .80 .90 .95 .80 1 .25 1 .70 1 .75 1 .60

Note.—Gage readings discontinued Jan. 8-Feb. 28. River frozen over.

Daily discharge, in second-feet, of Moose River at Moose River, N. Y., for 1910.

DAY.	Mar.	April.	May.	June.	July,	Aug.	Sept.	Oct,	Nov.	Dec.
Lienensen	6,060	4,660	2,240	800	265	278	252	1,220	855	375
2	5,820	4,510	2,140	1,080	278	278	240	1,060	855	345
3	5,110	4,280	2,140	1,320	265	278	215	1,020	910	390
4	3,860	4,070	2,040	1,080	290	800	240	965	910	90
5	3,140	3,260	2,140	1,080	315	2,040	240	882	938	420
6	2,780	3,080	2,290	1,290	345	1,290	265	800	938	500
7	2,780	3,460	1,990	1,550	315	1,120	302	725	910	465
8	2,670	3,140	1,720	1,720	278	938	405	700	828	390
9. ventile and the section of the se	2,780	2,290	1,430	1,670	290	750	390	630	775	278
0	2,780	1,850	1,220	1,550	265	828	375	610	750	240
1	2,620	1,400	1,020	1,320	265	1,150	375	570	700	240
2	2,450	1,260	828	1,290	240	1,400	405	535	650	215
3	2,290	1,150	650	1,080	240	1,220	390	482	650	215
4	2,240	1,120	465	800	240	965	420	465	610	240
5	2,140	995	135	700	240	910	420	465	610	240
0	1,940	965	345	630	240	855	375	90	570	265
7	1,550	965	405	610	135	775	405	465	518	240
8	1,360	910	482	570	240	675	405	465	500	215
9.,	1,220	910	610	535	265	610	360	500	465	215
20,	1,060	855	750	500	240	590	345	535	435	240
11	910	855	828	465	240	535	375	590	435	240
2	1,060	800	965	435	215	482	375	590	435	215
3,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	1.360	800	1,150	375	215	420	405	610	435	240
4	1,990	800	1,320	135	240	345	405	675	465	265
25	3.860	800	1,120	330	265	278	435	775	435	278
26	4.880	1,220	1,080	330	278	228	435	882	435	240
7	4,880	1,800	1,020	315	265	185	482	775	405	340
28	4,280	1,760	965	302	240	90	590	750	405	500
29	4,810	1,900	882	290	228	195	800	700	405	518
30	4.580	2,190	775	265	265	278	1,180	775	375	465
31	4,580		700	111111	302	265		800		420

Norm.— Ice conditions Jan. 1-Feb. 28. December may be somewhat in error due to ice conditions.

Monthly discharge of Moose River at Moose River, N. Y., for 1910. [Drainage area, 346 square miles.]

	Di	DISCHARGE IN SECOND-FEET.								
MONTH.	Maximum.	Minimum.	Mean.	Per square mile.	run-off in inches on drainage area.	Accu- racy.				
March	2,040	910 800 135 135 135 90 215 90 378	3,030 1,940 1,160 814 258 679 410 681 680 308	8.76 5.61 3.35 2.35 .746 1.96 1.18 1.97 1.79	10.10 6.26 3.86 2.62 .86 2.26 1.32 2.27 2.00 1.03	C B B A A A A B D				

ST. LAWRENCE RIVER DRAINAGE BASIN.

General Features.

St. Lawrence river, the outlet of the Great Lakes system, receives also the flow of a number of New York streams having their sources in the northerly slopes of the Adirondacks and fed by the innumerable lakes with which the region is dotted. Some of these rivers, as the Grass, Raquette, and St. Regis, lie entirely within the United States; others, notably Salmon, Trout, Chateaugay, and English rivers, cross the international boundary and flow northward into the St. Lawrence in Canada, as does also Richelieu river, the outlet of Lake Champlain. The following tables gives a list of the principal tributaries of the St. Lawrence in the United States, with the areas drained by them:

Drainage areas of St. Lawrence River tributaries in the United States.

	uare iles.	Square miles.
Oswegatchie River 1, Grasse River 1, Raquette River 1, 5t. Regis River 1, Little Salmon Rivera 1	637 Trout Riverb	129 199 53

The St. Lawrence drains, through Lake Champlain, an area of about 4,560 square miles in the State of Vermont. This drainage is practically all from Missisquoi, Lamoille, and Winooski rivers and Otter creek. Clyde Barton, and Black rivers, in northern Vermont, are tributary to St. Lawrence river through Lake Memphremagog and St. Francis river.

Oswegatchie River near Ogdensburg, N. Y.

This station, which is located at what is known as the Eel Weir highway bridge, about six miles upstream from Ogdensburg, N. Y., and one-half mile below Black Lake outlet, was established May 16, 1903, and has been main-

tained continuously since that date to obtain information for use in studies of power and storage development on Oswegatchie and Black rivers.

There are three dams in the vicinity of the gaging station on Oswegatchie river—one at Heuvelton, about 5 miles above; one at Rensselaer Falls, 10 miles above; and one in the city of Ogdensburg, about one-half mile above the outlet.

Open-water conditions prevail at this station throughout the year. The stream bed is rocky and permanent and the results are considered fairly good for all stages. The datum of the chain gage attached to the bridge has remained the same since the beginning of the record.

Information in regard to this station is contained in the annual reports of the New York State Engineer and Surveyor, and reports of the United States Geological Survey.

Discharge measurements of Oswegatchie River at Rel Weir bridge, near Ogdeneburg, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
Aug. 24	W. G. Hoyt	Feet. 150	Sq. ft. 297	Ft. per sec. 2.85	Feet. 4.78	Secft. 696

Daily gage height, in feet, of Oswegatchie River, at Eel Weir bridge, near Ogdensburg, N. Y., for 1910.

[Joseph La Rue, observer.]

DAY.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.10 5.20 5.00 5.20 5.00 4.90 4.80 4.83 4.83 5.00 6.24 6.45 6.45 6.43	6.1 6.0 5.8 5.8 5.5 5.5 5.5 5.5 5.2 5.1 5.1 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0	5.7.2.0.7.5.1 88.8.8.9.1.1 99.0.6.5.6.6.6.6.6.6.6.6.6.6.6.6.6.6.6.6.6	6.97 6.77 6.77 6.55 6.22 6.22 6.29 5.58 6.55 5.44 5.66 5.56 5.56 5.56 5.56 5.56	5.3 5.3 5.3 5.3 5.5 6.1 6.1 5.9 5.7 5.6 5.5 5.3 5.3 5.3 5.3 5.3 5.5 5.5 5.5 5.5	5.4 5.3 5.3 5.3 5.4 5.2 5.2 5.2 5.5 5.5 5.5 5.3 5.3 5.3 5.3 5.3 5.3 5.3	4.77 4.88 4.77 4.76 4.66 4.67 4.77 4.55 4.55 4.55 4.55 4.55 4.55	4.4.5 4.5.5 4.5.5 4.5.5 4.6.6 4.7.7 4.7.4.7 4.7.4.7 4.7.4.6 4.6.6 4.6.6 4.6.6 4.6.6 4.6.6 4.6.6 4.6.6 4.6.6 4.6.6 4.6.6 4.6.6 4.7.7 4.7.7 4.7.7 4.7.7 4.7.7 4.7.7 4.6.6 4.6.6 4.6.6 4.6.6 4.6.6 4.6.6 4.6.6 4.7.7 4.7.7 4.7.7 4.7.7 4.7.7 4.7.7 4.7.7 4.7.7 4.6.6 4.6.6 4.6.6 4.6.6 4.6.6 4.7.7	4.6 4.6 4.6 4.7 4.9 4.9 4.9 5.0 4.9 5.0 4.9 4.9 4.9 4.9 4.9 4.9 4.9 4.9 4.9 4.9	4.77 4.77 4.77 4.77 4.77 4.77 4.79 4.50 5.52 5.53 5.53 5.53 5.53 5.53 5.53 5.53	5.8 6.5 5.7 5.6 6.0 6.1 2.6 6.2 6.2 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0	5.98 5.88 5.88 5.87 5.76 6.65 6.43 5.22 5.11 5.00 5.00 5.00 5.00 5.11

Daily discharge, in second-feet, of Oswegatchie River at Bel Weir bridge, near Ogdensburg, N. Y., for 1910.

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,380	3,730	2.640	6,070	1,770	1,970	720	330	580	720	2,890	3,160
2	1,200	3,440	4,020	5,480	1,770	1,970	720	450	580	720	3,440	2,890
3	1,200	2,890	6,360	5,480	1,770	1,770	720	450	580	720	2,890	2,890
4	1,570	2,890	7,850	5,480	1,770	1,770	870	450	580	720	2,640	2,890
5	1,200	2,400	9,660	5,480	1,970	1,770	870	450	580	720	2,640	2,890
6	1,200		10,300	4,890	2,400	1,970	720	450	720	720	2,400	2,890
7	1,030		11,800	4,890	4,020	1,770	720	450	1,030	720	2,400	2,640
8	1,030		12,100	4,020	3,730	1,570	720	580	1,030	870	2,400	2,640
9	1,030		12,700	4,020	3,730	1,570	720	450	1,030	1,030	2,400	2,400
0.,,,,,,,	1,200		12,700	3,730	3,160	1,570	580	580	1,030	1,030	2,400	2,180
1,,,,,,,,	1,200		12,400	3,440	3,160	1,570	580	580	1,030	1,200	3,440	1,970
2	1,030		11,200	3,160	3,160	2,180	580	720	1,030	1,570	3,440	1,770
3	1,030		10,900	3,160	2,640	2,180 1,770	720 720	720 720	1,200	1,570	3,730	1,770
4	870		10,300	2,890	2,400				1,030	1,770	4,020	
5	870 870	1,200	9,050	2,400	2,400	1,770	720 580	720 720	1,200	1,770	4,310	1,570
6	870	1,200	8,150 7,250	2,400 1,970	2,180 1,970	1,770	580	720	1,030	1.770	4,310	1,380
7	870	1,030	6,070	1,970	1,770	1,380	580	720	1,030	1.770	3,730	1,380
8	870	1,030	5,180	1,970	1.570	1,380	580	580	1,030	1,570	3,440	1,380
9	1,200	1,030	5,180	2,400	1,380	1,380	330	580	1,030	1,570	3,440	1,200
1	1,200	1,030	5,180	2,400	1,770	1,380	330	720	870	1,570	3,440	1,200
9	1,570	1,030	5,180	2,400	1,770	1,380	330	720	870	1,380	3,440	1,200
3	2,180	1,200	5,180	2,400	1,770	1.380	450	720	870	1,380	3,160	1,200
4	3,440	1,200	5.180	2,400	1,770	1,200	450	580	870	1,200	3,160	1,200
5	4,020	1,200	5,780	2,180	1,970	1,200	450	580	1,200	1,200	2,890	1,200
6	4,600	1,200	5,780	2,400	2,180	1,200	450	580	1,030	1,200	2,890	1,200
7	4,600	1,200	6,070	2,400	2,180	1,200	450	580	1,030	1,200	2,890	1,200
8	4,890	1,570	6,660	1.770	1,970	1,030	450	580	870	1,570	3,160	1,380
9	4,600		6,660	1,770	2,180	870	450	580	870	1,770	3,440	1,380
0	4,310		6,660	1,770	2,180	870	450	580	870	2,180	3,440	1,380
1			6,960		1,970		330	580		2,890		1,570

Monthly discharge of Oswegatchie River, Eel Weir bridge, near Ogdensburg, N. Y., for 1910.
[Drainage area, 1580 square miles.]

	Dı	BCHARGE IN	SECOND-FEI	FT.	Depth of		
MONTH.	Maximum.	Minimum.	Mean.	Per square mile.	run-off in inches on drainage area.	Accu	
January February March April May June July August September October November	3,730 12,700 6,070 4,020 2,180 870 720 1,200 2,890	870 1,030 2,640 1,770 1,880 870 330 330 580 720 2,400 1,200	1,960 1,670 7,780 3,240 2,270 1,550 578 588 924 1,350 3,210 1,840	1.24 1.06 4.92 2.05 1.44 .981 .366 .372 .585 .854 2.03	1.43 1.10 5.67 2.29 1.66 1.09 .42 .43 .65 .98 2.26	BB A A A A A A A B B	
The year		330	2,250	1.42	19.32	-	

RAQUETTE RIVER DRAINAGE BASIN.

Description.

Raquette river rises in northern Hamilton county, flows practically north through a long narrow valley to St. Lawrence river. It has a total length of 162 miles, from its source to its confluence with the St. Lawrence, near the most northern point of the state.

Its source is on an elevated plateau of some 1,600 feet above sea level. The upper water-shed includes many acres of swamp land, as well as a large area of lakes and ponds, including Tupper lake, Little Tupper lake, Long lake, Round lake, Blue Mountain lake, Forked lake and Raquette lake.

The high region is most prolific in rain-fall, the mean annual amounting to about 48 inches, or about 10 inches above the mean for the State.

In its course through the mountains the river exhibits many falls and rapids, inviting power development under private enterprise. As yet, however, only 400 feet of the 1,400 feet of fall in the river, below Tupper lake, has been developed. The river has tremendous fluctuations between the maximum and minimum flow and is in great need of artificial regulation if the best possibilities of power development are to be realized. The State Water Supply Commission of New York have under consideration extensive storage developments on this stream which, when completed, will materially benefit the existing powers and tend to make the undeveloped portions of greater economic importance.

A discharge measurement of Raquette river was made by C. C. Covert July 22, 1910, at a point near Hosley Camp No. 2, about one mile below Forked lake outlet. Gage height, Forked lake gage 1,741.6 feet; discharge, 60.4 Second-feet.

Raquette River at Raquette Falls, near Coreys, N. Y.

This station is near the center of Raquette falls about 6 miles, by river, upstream from the village of Axton, which is 12 miles, by road, from the village of Tupper Lake. The station was established August 27, 1909, in co-operation with the U. S. Geological Survey, to obtain general statistical and comparative data regarding the flow of Raquette river.

The river has one channel for all stages. The current is favorable for making discharge measurements. The bed of the river is rocky, composed of large boulders, and is permanent. During low water the current is sluggish. At high and medium stages the current is suitable for good discharge measurements.

Measurements are made from a car hung from a cable which was erected during the summer of 1909. Previous to that time measurements were made by wading about 2,000 feet down stream.

A gage reader is only obtainable during the summer, therefore no winter records are available.

The datum of the staff gage has remained the same during the maintenance of the station. The low water portion of the curve is well defined. No measurements have, as yet, been made to determine the high water discharge.

Information in regard to this station is contained in annual reports of the U. S. Geological Survey.

Discharge measurements of Raquette River at Raquette Falls, near Coreys, N. Y., in 1910.

DATE.	Hydrographer,	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
April 1 May 26 July 7 July 23 Nov. 7	C. C. Covert. W. G. Hoyt. W. G. Hoyt. C. C. Covert. F. J. Shuttleworth.	Feet. 106 89 88 67 89	Sq. ft. 623 424 252 184 258	Ft. per sec. 5.99 2.41 1.17 .77 1.82	Feet. 5.8 4.26 2.00 1.40 2.54	Secft. 3,730 (a)1,020 294 141 470

(a) Log jam below gage.

Daily gage height, in feet, of Raquette River at Raquette Falls, near Coreys, N. Y., for 1910. [C. A. DeLancett, observer.]

DAY.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
12 3		5.75 5.8 5.6 5.4 5.4	4.2 4.4 4.5 5.1 5.6	4.3 4.5 4.5 4.0 3.8	2.4 2.2 2.1 2.1 2.1	1.5 1.5 1.4 1.7	1.6 1.7 1.7 1.8 1.9	1.9 2.0 2.0 2.0 2.0	2.4 2.4 2.4 2.4 2.4	2.1 2.1 2.1 2.1 2.1
6 7		5.3 5.4 5.5 5.4 5.4 5.4	5.4 5.2 5.2 5.1 5.1 5.0	3.9 4.0 4.2 4.1 4.1 4.1	2.1 2.0 1.9 1.8 1.8	1.9 1.8 1.7 1.7 1.7	2.5 2.5 2.4 2.3 2.2	2.0 2.0 2.0 2.0 2.0 2.0	2.4 2.5 2.5 2.5 2.5 2.5	2.1 2.2 2.4 2.7 2.8
2		5.1 4.9 4.7 4.7 4.5	4.8 4.6 4.4 4.3 4.3	4.1 3.9 3.8 3.6 3.6 3.6	1.8 1.8 1.7 1.6 1.6	1.6 1.6 1.8 1.8	2.2 2.2 2.1 2.1 2.0 2.0	2.0 2.0 2.0 2.0 2.0	2.4 2.4 2.4 2.3 2.3	3.0 2.1 2.1 2.1
7		4.5 4.7 5.1 4.9 5.1	4.4 4.4 4.0 4.1 3.9	3.6 3.5 3.4 3.3 3.2	1.6 1.5 1.5 1.5	2.0 1.9 1.8 1.8	2.0 2.0 2.0 1.9	1.9 1.9 1.9 1.8 1.8	2.3 2.2 2.2 2.2 2.2	2. 2. 1. 1.
34 4		4.9 4.7 4.5 4.4 4.3	3.5 3.7 3.9 4.1 4.3	3.0 2.9 2.8 2.8 2.7	1.4 1.4 1.5 1.6	1.6 1.6 1.7 1.8	1.9 1.9 1.8 1.8	1.9 1.9 2.1 2.3 2.3	2.2 2.1 2.1 2.1 2.1	1.9 1.9 1.9 1.9
89		4.3 4.2 4.2	4.8 3.7 3.8 4.3	2.6 2.5 2.4	1.6 1.5 1.5 1.5	1.7 1.7 1.6 1.6	1.8 1.8 1.8	2.8 2.3 2.4 2.4	2.1 2.1 2.2	1. 1. 2. 2.

Daily discharge, in second-feet, of Raquette River at Raquette Falls, near Coreys, N. Y., for 1910.

DAY.	Mar.	April.	Мау.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3,660 3,740	1,640 1,860	1,750 1,970	420 350	170 170	190 215	265 290	420 420	320 320
3 4		3,430 3,130 3,130	1,970 2,700 3,430	1,970 1,450 1,280	320 320 320	150 215 265	215 240 265	290 290 290	420 420 420	320 320 320
6 7 8		2,980 3,130 3,280	3,130 2,840 2,840	1,360 1,450 1,640	320 290 265	265 240 215	460 460 460	290 290 290	420 460 460 460	320 350
9 10 11		3,130 3,130 3,130 2,700	2,700 2,700 2,570 2,320	1,540 1,540 1,540 1,540	265 240 240 240	215 215 190 190	420 385 350 350	290 290 290 290	460 420 420	
12 13 14 15		2,440 2,200 2,200	2,080 1,860 1,750	1,360 1,280 1,120	240 215 190	190 190 240	350 320 320	290 290 290 290	420 420 420	
16 17 18		1,970 1,970 1,970	1,750 1,750 1,860	1,120 1,120 1,120	190 190 190	240 265 290	290 290 290	290 290 265	385 385 385	
19 20 21		2,200 2,700 2,440	1,860 1,450 1,540	1,040 970 900	170 170 170	265 240 240	290 290 265	265 265 240	350 350 350	
22			1,360 1,040 1,200	830 710 655	170 150 150	215 190 190	265 265 265	240 265 265	350 350 320	
25 26 27		1,970 1,860 1,750	1,360 1,540 1,750	600 600 550	150 170 190	215 240 240	265 240 240	320 385 385	320 320 320	
28 29 30	2,770	1,750 1,640 1,640	2,320 1,200 1,280	505 460 420	190 170 170	215 215 190	240 240 240	385 385 420	320 320 350	
31		l	1,750	l	170	190	1	420	l	<u> </u>

NOTE.—Daily discharge based on a fairly well defined rating. Ice conditions which prevailed at this station during December, render the giving of daily discharge impossible.

Monthly discharge of Raquette River at Raquette Falls, near Coreys, N. Y., for 1910.
[Drainage area, 418 square miles.]

	Dı	Depth of				
MONTH.	Maximum.	Minimum.	Mean.	Per square mile.	run-off in inches on drainage area.	Accu-
April May June June July August September October November	1,970 420 290	1,640 1,040 420 150 150 190 240 320	2,550 1,980 1,150 226 218 299 304 388	6.10 4.74 2.75 .541 .522 .715 .727	6.81 5.46 3.07 .62 .60 .80 .84	

Raquette River at Picrcefield, N. Y.

This station is located at the head of Black rapids, about one-half mile downstream from the dam of the International Paper Company in the town of Piercefield. It was established August 20, 1908, in co-operation with the U. S. Geological Survey to obtain general and statistical data regarding the flow of the Raquette.

There is one channel at all stages. The current is good at medium and high water stages but becomes sluggish under low water conditions. Discharge measurements are made at low and medium stages by means of a boat fastened to a wire, stretched immediately above the head of the rapids.

During high water, measurements are made from the highway bridge above the paper mills. Ice seldom forms at the boat section and in consequence the open water curve has been used throughout the entire year.

A vertical staff gage was formerly located one-third mile upstream from the boat section and about 1,000 feet below the tailrace of the International Paper Company's mill. On September 3, 1910, this staff gage was removed and a chain gage established at the same site and datum. The datum of the gage has remained fairly permanent during the maintenance of the station. The rating table is fairly well defined.

Information in regard to this station is contained in annual reports of the U. S. Geological Survey.

Discharge measurements of Raquette River at Piercefield, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
Mar. 28 Mar. 31 May 27 July 8 Aug. 19	C. C. Covert. C. C. Covert. W. G. Hoyt. W. G. Hoyt. W. G. Hoyt.	Feet. 124 124 124 97 98	Sq. ft. 2,020 2,020 1,920 548 499	Ft. per sec. 1.44 1.82 1.26 1.07 1.13	Feet. 5.7 6.6 5.25 2.22 2.12	Secft. (a)2,920 (a)3,670 (a)2,430 586 566

⁽a) Measurements made at highway bridge above dam. Pond above and underneath bridge full of pulp wood, which affected surface velocities.

Other measure made from boat at cable.

Daily gage height, in feet, of Raquette River at Piercefield, N. Y., for 1910.
[W. B. Graves, observer.]

				. G18								
DAY.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.00 1.95 2.00 2.00 2.00 2.00 2.00 2.00 2.00 2.0	2.65 2.60 2.60 2.50 2.70 2.70 2.70 2.70 2.70 2.70 2.70 2.7	2.40 2.70 2.70 2.70 1.85 4.25 4.25 4.25 4.25 4.25 4.25 4.25 4.2	7.457 7.50 7.50 7.50 7.50 7.50 7.50 7.50 7.	5.40 5.60 5.60 5.60 5.40 5.40 5.40		4.80 4.35 1.00 3.50 2.90 2.25 2.25 2.20 1.00 2.20 2.20 2.20 2.20 2.20 2.20	1.60 1.40 1.40 1.40 1.40 1.00 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	0.0 1.812 2.10 2.20 2.20 2.20 2.20 2.20 2.20 2.	2.1 1.00 2.15 2.20 2.15 2.20 2.10 2.15 2.20 2.20 2.20 2.35 2.40 2.40 2.15 2.20 2.40 2.15 2.20 2.40 2.15 2.20 2.40 2.15 2.40 2.15 2.40 2.40 2.40 2.40 2.40 2.40 2.40 2.40	2.4 2.48 2.58 2.50 1.55 2.25 2.65 2.75 0.0 0.0 3.05 3.10 3.00 3.00 3.00 3.00 3.00 3.00 3.00	2.30 0.0 2.12 2.25 2.20 2.00 1.90 0.0

NOTE.— Gage heights January 1 to March 12 are to top of ice. Readings are very poor for this period. June 1 to 24, inclusive, readings considered unreliable.

Daily discharge, in second-feet, of Raquette River at Piercefield, N. Y., for 1910.

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1	487	735	635	(3,820)	3,980		2,020	369	456	521	635	675
2	218	715	755	(4,720)	3,980		1,680	316	426	218	667	595
3	487	715	755	4.720	3,980		218	316	397	303	675	593
1	472	(715)	755	4,780	4,040		218	290	90	521	707	90
5	(480)	715	755	4.780	4,040		1.160	316	90	539	675	528
3	487	342	441	4.840	3.870		1,000	316	441	521	101	570
7	(472)	675	1,080	4,780	3,760	211111	845	90	528	539	356	55
3	456	755	1,600	4,780	3,560		576	90	521	557	576	48
9	241	715	1,600	4,780	3,560		595	383	539	101	635	45
)	487	(715)	1,600	4,540	3,560		218	487	557	186	920	45
1	(487)	(675)	1,600	4,780	3,560		521	90	90	412	735	9
2	487	675	1,600	4.780	3,500		557	90	1,020	521	778	
3	715	635	1,220	4,780	3,450		472	90	595	504	90	
4	715	755	2,020	4,660	3,050		557	90	472	521	397	
5	487	(755)	2,020	4,540	2,600		487	90	412	487	920	
6	241	755	2,060	4,320	2,750		456	90	456	101	995	
7	(356)	(755)	2,060	3,980	2,700		218	90	369	504	970	
8	472	755	2,060	3,920	2,650		487	218	105	557	920	
9	426	755	2,020	4,090	2,560		487	539	557	615	945	
0	487	755	1,900	3,560	2,290		504	383	557	635	90	
1	(487)	755	1,900	3.660	2,560		521	114	557	635	369	
2	487	755	1,860	3,560	2,750		539	90	557	635	635	
3	218	755	1,780	3,560	2,750		557	295		101	800	
4	655	755	1,780	3.050	2.750		218	456	557	290	895	
5	675	755	1,780	4,200	2,750	2,020	412	539	105	504	895	****
6	675	845	2,020	3,980	2,560	1,860	539	504	218	539	945	
7		456	2,290	3,980	2,560	2,020	557	487	303	557	90	1
8	675	(456)	3,250	4,090	2,560	2,560	557	105	539	603	383	
9	675	(400)	3,560		2,560	2,560	472	90	557	635	635	***
0	521		4,090		2,560	2,020	456	412	521	105	675	
1	695		3,820		2,560	2,020	90	504	021	356	019	* * *
1	030		0,020		4,400	17.52.55	30	OUT		000	9 2 - 2 2	*/7.5

NOTE.—Gage heights questionable June 1 to 24 and December 12 to 31. Discharge for these periods withheld.

Monthly discharge of Raquette River at Piercefield, N. Y., for 1910.
[Drainage area, 723 square miles.]

	1	DISCHARGE IN SECOND-FEET.									
MONTH.	Maximum.	Minimum.	Mean.	Per square. mile.	run-off in inches on drainage area.	Accu- racy.					
January February March April May June July August September October November	845 4,090 4,840 4,040 2,020 539 1,020	218 342 635 3,050 2,290 90 90 90 133 240	503 700 1,830 4,270 3,110 (2,040) 587 259 438 443 736	.696 .968 2.53 5.91 4.30 (2.82) .812 .358 .606 1.68 2.79	.80 1.01 2.92 6.59 4.96 (2.28) .94 .41 .68 1.94 3.11	B B A A A D A B A A A					

Note.— Discharge for June based on records at Massena Springs.

Raquette River at Massena Springs, N. Y.

This station is located at the highway bridge at Massena Springs, N. Y. It was established September 21, 1903, was temporarily discontinued October 17, 1903, and resumed April 9, 1904. It is maintained to obtain data regarding the total flow of the river.

The nearest power development is at Raymondville, about eight miles above the station. The Sunday flow of this stream is often held back during the low-water season while ponds at mills above are being refilled, and under these conditions the effect may be shown in the stream for several days.

The vertical staff gage, attached to the right abutment of the upstream side of the bridge from which measurements are made, was replaced on August 15, 1906, by a standard chain gage on the bridge at a datum 1.00 foot lower in order to avoid minus readings. All gage heights during 1903 and thereafter are referred to this new datum. Conditions for obtaining accurate discharge measurements are good, and a good rating table has been developed. During the winter months the discharge is affected by ice.

Information in regard to this station is contained in the annual reports of the New York State Water Supply Commission and the State Engineer and Surveyor and U. S. Geological Survey.

Discharge measurements of Raquette River at Massena Springs, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
Mar. 30 Aug. 23	C. C. Covert W. G. Hoyt.	Feet. 173 166	Sq. ft. 1,110 341	Ft. per sec. 4.22 1.75	Feet. 6.38 1.90	Secft . 4,680 597

Daily gage height, in feet, of Raquette River at Massena Springs, N. Y., for 1910.

[F. L. Babcock, observer.]

Daily discharge, in second-feet, of Raquette River at Piercefield, N. Y., for 1910.

DAY.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1	487	735	635	(3,820)	3,980		2,020	369	456	521	635	675
2	218	715	755	(4,720)	3,980	*****	1,680	316	426	218	667	595
3	487	715	755	4,720	3,980		218	316	397	303	675	595
4	472	(715)	755	4,780	4,040		218	290	90	521	707	90
5	(480)	715	755	4,780	4,040	*****	1,160	316	90	539	675	528
6	487	342	441	4.840	3,870		1,000	316	441	521	101	576
7	(472)	675	1,080	4,780	3,760		845	90	528	539	356	557
8	456	755	1,600	4,780	3,560		576	90	521	557	576	487
9	241	715	1,600	4,780	3,560		595	383	539	101	635	456
0	487	(715)	1,600	4,540	3,560		218	487	557	186	920	456
1	(487)	(675)	1,600	4.780	3,560		521	90	90	412	735	90
2	487	675	1,600	4,780	3,500		557	90	1,020	521	778	
3	715	635	1,220	4,780	3,450		472	90	595	504	90	
4	715	755	2,020	4,660	3,050		557	90	472	521	397	
5	487	(755)	2,020	4,540	2,600		487	90	412	487	920	
6	241	755	2,060	4,320	2,750		456	90	456	101	995	
7	(356)	(755)	2,060	3,980	2,700		218	90	369	504	970	
8	472	755	2,060	3.920	2,650		487	218	105	557	920	
9	426	755	2.020	4.090	2,560		487	539	557	615	945	
0	487	755	1,900	3,560	2,290		504	383	557	635	90	
1,,,,,,,,,,,	(487)	755	1,900	3.660	2,560		521	114	557	635	369	
2	487	755	1.860	3,560	2,750		539	90	557	635	635	
3	218	755	1,780	3,560	2,750		557	295	557	101	800	
4	655	755	1.780		2,750		218	456	557	290	895	
5	675	755	1,780		2,750	2,020	412	539	105	504	895	
6	675	845	2,020		2,560	1,860	539	504	218	539	945	
7	675	456	2,290		2,560	2,020	557	487	303	557	90	
8	675	(456)	3,250		2,560	2,560	557	105	539	603		0000
9	675		3,560		2,560	2,560	472	90	557	635		
0	521		4.090		2.560	2,020	456	412	521	105		
1	695		3.820		2,560	V	90	504		356		110

Note.—Gage heights questionable June 1 to 24 and December 12 to 31. Discharge for these periods withheld.

Errata table of monthly discharge at Piercefield for 1910, page 364, 6th Annual Report of the State Water Supply Commission.

USE THESE VALUES.

	Dı	Depth of run-off in			
MONTH.	Maximum.	Minimum.	Mean.	Per square mile.	inches on drainage area.
June		 101 90 90	269 446 637 410	372 .617 .881 .567	(3.15) .43 .71 .98 .65

IN was commission deptention 21, 1905, was temporarily discontinued October 17, 1903, and resumed April 9, 1904. It is maintained to obtain data regarding the total flow of the river.

The nearest power development is at Raymondville, about eight miles above the station. The Sunday flow of this stream is often held back during the lowwater season while ponds at mills above are being refilled, and under these conditions the effect may be shown in the stream for several days.

The vertical staff gage, attached to the right abutment of the upstream side of the bridge from which measurements are made, was replaced on August 15, 1906, by a standard chain gage on the bridge at a datum 1.00 foot lower in order to avoid minus readings. All gage heights during 1903 and thereafter are referred to this new datum. Conditions for obtaining accurate discharge measurements are good, and a good rating table has been developed. During the winter months the discharge is affected by ice.

Information in regard to this station is contained in the annual reports of the New York State Water Supply Commission and the State Engineer and Surveyor and U. S. Geological Survey.

Discharge measurements of Raquette River at Massena Springs, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
Mar. 30 Aug. 23	C. C. Covert W. G. Hoyt	Feet. 173 166	Sq. ft. 1,110 341	Ft. per sec. 4.22 1.75	Feet. 6.38 1.90	Secft . 4,680 597

Daily gage height, in feet, of Raquette River at Massena Springs, N. Y., for 1910.
[F. L. Babcock, observer.]

e. July. Aug.	May. June.	r. April.	Mar.	DAY.			
35 3.20 2.00 35 3.10 2.10 35 2.30 1.90 10 3.85 1.75 2.80 1.85 2.00 1.85 2.00 1.85 2.00 1.75 2.80 35 2.25 1.70 75 2.25 1.60 20 1.75 1.88 30 2.15 1.75 35 2.05 1.80 35 2.05 1.80 35 2.05 1.80 35 2.15 1.45 35 2.05 1.80 35 2.15 1.45 35 1.70 1.85 36 2.15 1.45 36 1.25 1.5 36 1.25 1.70 37 1.60 1.90 38 2.05 1.70 39 2.25 1.70 30 2.25 </th <th>4.70 4.65 4.70 4.65 5.05 4.35 5.05 4.35 5.95 4.10 5.65 4.80 5.65 4.80 5.65 4.80 5.65 4.75 5.65 4.75 5.65 4.75 5.65 4.90 5.70 4.50 5.70 4.50 5.25 4.45 5.25 4.45 6.25 4.35 6.25 4.35 6.30</th> <th>7.10 7.20 7.15 7.05 7.05 7.05 7.05 6.95 0.6.</th> <th></th> <th>1</th>	4.70 4.65 4.70 4.65 5.05 4.35 5.05 4.35 5.95 4.10 5.65 4.80 5.65 4.80 5.65 4.80 5.65 4.75 5.65 4.75 5.65 4.75 5.65 4.90 5.70 4.50 5.70 4.50 5.25 4.45 5.25 4.45 6.25 4.35 6.25 4.35 6.30	7.10 7.20 7.15 7.05 7.05 7.05 7.05 6.95 0.6.		1			

Nors. - River frosen over January 1 to March 11 and December 1 to 31 inclusive.

Daily discharge, in second-feet, of Raquette River at Massena Springs, N. Y., for 1910.

Note. -- Ice conditions March 1 to March 11; daily discharge estimated.

Monthly discharge of Raquette River at Massena Springs, N. Y., for 1910.
[Drainage area, 1,170 square miles.]

	Dr	SCHARGE IN	Second-Fe	ET.	Depth of	
MONTH.	Maximum. Minimum. Mean.		Mean.	Per square mile.	inches on drainage area.	Accu- racy.
January February March April May June July August September October November	631 (6,310) 5,520 4,110 3,080 1,590 1,160 1,060 1,590 1,630	(1,050) 2,980 2,460 1,350 433 284 284 388 457	(690) (960) (4,040) 4,560 3,210 2,390 770 538 666 926 1,210	(590) (820) (345) 3.90 2.74 2.04 .658 .460 .569 .791	(68) (85) (3.98) 4.35 3.16 2.28 .76 .53 .63 .91	D D B A A A A A A A B

Bog River near Tupper Lake, N. Y.

This station is located above Bog river falls, about 300 feet below the forks of Tupper lake stream and Bog river, about two and one-half miles above Big Tupper lake in the town of Piercefield, and about 11 miles southwest of the town of Tupper Lake. It was established August 24, 1908, to obtain data for use in water power and storage investigations.

Since the summer of 1909 discharge measurements are made from a car hung on a cable. Before that time the measurements were made by wading or from a boat.

The staff gage is located about two and one-half miles downstream at the head of Bog river falls and is within a few rods of Big Tupper lake. The elevation of the zero of the gage, based on the United States Geological Survey bench mark at Tupper Lake Junction, according to the levels of the State Water Supply Commission of New York, is 1,563.76 feet above mean tide. The bed of the stream is sandy and contains scattered boulders, but it is probably permanent and a good low-water rating curve has been developed.

Gage readings previous to 1910 were obtained either by a recording gage or by hydrographers and other engineers who periodically visit the station. Information in regard to this station is contained in the annual reports of the U. S. Geological Survey.

Discharge measurements of Bog River near Tupper Lake, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
April 2 May 20 May 25 July 6	C. C. Covert. W. G. Hoyt. W. G. Hoyt. W. G. Hoyt.	Feet. 72 65 75 51	8q. ft. 220 245 289 108	Ft. per sec. 1.67 2.02 2.30 .94	Feet. 2.82 5.06 3.35 1.53	Secft. 368 444 664 101

Daily gage height, in feet, of Bog River near Tupper Lake, N. Y., for 1910.
[B. O. Lott, observer.]

DAY.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22.		2.1 5.055 4.955 3.8 3.6 4.45 5.95 4.80 4.3 2.1 2.3 2.1 2.1 2.3 4.6 5.3	333333220865557876555680866 202222222222222222222222222222222	1.3 1.3 1.2 1.2 1.4 1.5 1.3 1.3 1.3 1.1 1.1 1.1 1.1 1.1	1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.1 1.2 1.2 1.2 1.1 1.0 1.0 1.0	1.0 1.1 1.3 1.3 1.2 1.2 1.4 1.5 1.5 1.5 1.5 1.4 1.3 1.3 1.3	1.4 1.5 1.5 1.4 1.5 1.3 1.3 1.3 1.5 1.5 1.4 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5	1.6 1.6 1.6 1.7 1.8 1.7 1.7 1.7 1.7 2.0 2.3 2.3 2.3 2.3 2.3 2.3
23. 24 25. 26. 27. 28. 29. 30. 31.	3.1 2.1 1.2 1.6 1.9 1.9 2.0 5.05	3.0 3.4 3.4 3.4 3.4 3.4 3.5 3.4	2.4 2.1 2.0 1.8 1.5 1.4 1.4	1.1 1.0 1.0 1.0 1.1 1.1 1.1	1.0 1.0 1.0 .9 .8 .8 .8	1.3 1.3 1.3 1.3 1.3 1.3 1.3	1.5 1.5 1.6 1.6 1.7 1.7 1.6	2.3 2.4 2.4 2.1 2.0 2.0 1.9

Daily discharge, in second-feet, of Bog River, near Tupper Lake, N. Y., for 1910.

DAY.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		186	625	60	28	28	72	100
2		1.650	580	60	28	37	85	liŏo
3	495	1.580	535	60	28	48	85	100
4	340	325	535	48	28	60	72	iŏŏ
5	495	825	455	48	28	60	85	115
6	415	720	375	72	28	48	85	131
7	208	1.230	310	85	28	48	85	131
8	770	254	280	85	28	60	72	115
9	825	1.610	280	72	37	72	60	115
0	670	1.580	340	48	48	85	80	iiš
1	825	1.470	375	60	48	92	eo l	131
2	1,060	1.130	340	eo i	48	85	72	148
13	770	340	310	48	37	85	85	148
4	720	230	280	37	28	72	85	166
5	625	186	280	37	28	72	100	230
6	1.690	186	280	37	28	eñ.	85	254
7	1.470	186	310	37	37	48	72	230
8	1.330	230	375	37	37	60	72	230
9	340	208	455	37	28	añ l	60	230
20	1.000	1.330	375	37	28	60	60	230
21	1.300	1.260	310	37	28	72	85	230
22	148	495	310	37	28	60	100	230
3	495	455	254	37	28	ão	85	230
24	186	535	186	37	28	ÃÕ	85	230
5	48	648	166	28	28	ão l	85	254
86	100	625	131	28	20	60	100	254
7	148	625	85	28	14	60	100	186
8	148	625	72	37	14	60	115	166
iii	166	625	72	37	14	80	115	166
io	1.650	670	72	48	14	8õ	100	148
1	1,500	625		37	20	••	100	140

Now. \rightarrow This station discontinued during the period of ice conditions. Daily discharges for the open channel periods, based on a well defined rating.

Monthly discharge of Bog River near Tupper Lake, N. Y., for 1910.
[Drainage area, 132 square miles.]

	Dı	SCHARGE IN	SECOND-FEI	et.	Depth of	
MONTH.	Maximum.	Minimum.	Mean.	Per square mile.	inches on drainage area.	Accu- racy.
April (3-30) May. June July August September October November	625 85 48 92	48 186 72 28 14 28 60 100	658 730 312 47.0 28.8 61.7 83.3	4.98 5.53 2.36 .356 .218 .467 .631	5.19 6.38 2.63 .41 .25 .52 .73	D C B B B B B B B

ST, REGIS RIVER DRAINAGE. Description.

The St. Regis river has its source in several small streams and lakes in the western part of Franklin county at an elevation of about 1,500 feet above the sea. It first flows in a northwesterly direction for about forty-miles and then somewhat east of north for about 28 miles to its mouth, in the St. Lawrence river near the State line. It has a drainage area of 664 square miles (State Water Supply Commission). The upper portion of its water shed consists of swamp and mountains from which the forest has been largely cut. Upon leaving the plateau the stream descends for 10 or 15 miles through a rugged country with a succession of steep rapids and precipitous falls to the low lands bordering the St. Lawrence.

There are excellent opportunities for developing power in the descent, only a few of which have as yet been utilized. From the foot of the hills to the St. Lawrence, the slope of the river is moderate and rock out-crop not frequent, consequently favorable sites for power development are scarce. According to report of the State Water Supply Commission for 1910, the present limit of profitable development through this low country, except as increased by regulation of stream flow has probably been reached in the existing plants. A detailed description, showing all power developments and future possible developments is given in the 1910 report of the State Supply Commission.

St. Regis River at Brasher Center, N. Y.

This station is located in the village of Brasher Center, 5 miles downstream from Brasher Falls, and about 12 miles above the mouth of the river. It was established August 22, 1910, in co-operation with the U. S. Geological Survey to obtain information regarding the flow of the St. Regis river.

A chain gage is located on the downstream side of the bridge, over the right-hand channel. Low water measurements have been made by wading about 500 feet above the bridge, and high water measurements are made from the bridge. A rating table is not developed as yet and only discharge measurements and gage heights are published.

Discharge measurements of St. Regis River at Brasher Center, near Brasher Falls, N. Y., in 1910.

DATE.	Hydrographer.	Width.	th. Area of Mean velocity.		Gage height.	Dis- charge.	
July 25 Aug. 20	C. C. Covert	Feet. 160 216	Sq. ft. 196 359	Ft. per sec. .90 1.40	Feet. (a) 19.36 4.48	Secft. 176 (b) 505	

⁽a) Distance to water surface from reference point on first bridge above Helena.(b) Measurement made at wading section, 200 feet up stream from gage.

DAY.	Sept.	Oct.	Nov.	Dec.	DAY.	Aug.	Sept.	Oct.	Nov.
1	4.12 4.10 4.22 4.18 4.16 4.22 5.12	4.12 4.10 4.10 4.25 4.32 4.40 5.18	4.85 4.85 4.72 4.78 4.78 4.88 4.98	4.42 4.58 4.55 4.70 4.80 4.68 5.20	18	4.25 4.16 4.05	4.20 4.20 4.10 4.12 4.12 4.16 4.10	4.38 4.30 4.35 4.25 4.10 4.12 4.25	4.55 4.62 4.65 4.48 4.52 4.50 4.42
89	5.22 4.96 4.70 4.55 4.41 4.32	5.50 5.40 5.22 4.95 4.75 4.50	4.88 4.82 4.78 5.05 5.08 4.98	5.20 5.85 6.00 6.05 6.05 5.98	25 26 27 28 29 30	4.11 4.15 4.25 4.02 3.95 3.50	4.12 4.10 4.12 4.18 4.20 4.12	4.60 5.25 5.45 5.50 5.40 5.35	4.64 4.64 4.64 4.64 4.64

Daily gage height, in feet, of St. Regis Riser, at Brasher Center, near Brasher Falls, N. Y., for 1910.
[George Myers, observer.]

Note. -- Ice conditions Dec. 18-31. No gage heights during this period.

LAKE CHAMPLAIN DRAINAGE BASIN.

Description.

Lake Champlain occupies a long and narrow valley, extending in a northsouth direction and forming a part of the boundary between New York and Vermont. The elevation of the lake is about 95 feet above tide, and the water-surface area is 436 square miles.

The drainage basin is irregular in form, being about 75 miles wide from a point opposite Middlebury, Vt., northward to the outlet of the lake at Rouse Point, on the international boundary. South of Middlebury the average width of the basin is about 35 miles, and the lake itself is very narrow, forming virtually a drowned river.

The tributary region is rugged and mountainous, covered with little depth of soil except in the stream valleys. The drainage is received almost entirely through large tributaries, there being little direct coast drainage into the lake. The outlet of the lake is Richelieu river, which flows northward from Rouse Point to St. Lawrence river. The total drainage area at the mouth of the lake is about 7.900 square miles (including lake surface).

AUSABLE RIVER DRAINAGE BASIN.

Description.

The Ausable river is formed by the junction of the east and west branches which have their head waters in the northwestern part of Essex county. The east branch has its source in upper Ausable lake, at an elevation of 1,990 feet above sea level. The west branch is formed by several small streams which lie in the valley to the west and north of the east branch. Both branches flow north and east to their junction in the village of Ausable Forks, from which point the river flows northeast, entering Lake Champlain about 10 miles south of Plattsburg and opposite and slightly north of the city of Burlington.

Throughout the entire course, the river is fed by small mountain streams, which enter at nearly right angles from the mountains on either side. There are few lakes in this drainage area to act as a regulator on the flow and, owing to the great differences of elevation throughout the area, the stream has what is called a flashy discharge, its fluctuations being large and rapid.

Owing to the fact that this basin lies on the eastern slope of the Adirondack mountains, the average rain fall is less than for those basins whose streams which rise on the western and southern slopes, the mean yearly precipitation being about 32 inches.

About 6,000 water horsepower is developed at the present time, principally on the west branch. For additional development and storage possibilities on this stream see Fifth Annual Report of Water Supply Commission, pages 88, 147, 267.

Ausable River at Ausable Forks, N. Y.

This station is located in the village of Ausable Forks, about 15 miles above the mouth of the river, immediately below the junction of the east and west branches. It was established August 27, 1910, in co-operation with the U. S. Geological Survey to obtain information regarding the flow of the Ausable river.

A standard chain gage is fastened to a cantilever arm on the right hand bank about 40 feet below the confluence of the east and west branches, in the village of Ausable Forks. Measurements during this year have been made further down stream by wading.

On December 7, 1910, there was installed, 2 miles below the gage, a cable station, at which future measurements will be made.

Discharge measurements of Ausable River at Ausable Forks, N. Y., in 1910.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
Aug. 17 Dec. 9	W. G. Hoyt	Feet. 207 182	Sq. ft. 314 313	Ft. per sec. 1.04 .866	Feet. 3.77 3.85	Secft. (a)327 (b)271

East Branch, Ausable River.

DATE.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Dis- charge.
Oct. 29	C. C. Covert	Feet. 137	Sq. ft. 190	Ft. per sec. 1.52	Feet. *17.75	Secft. 289

^{*} Distance to reference point.

⁽a) Measurement made at wading section.
(b) Measurement made under partial ice cover at cable station.

Daily gage height, in feet,	of	A usable	River,	at	Ausable Po	rke,	N.	Y., for	1910.
	[H	i. Edwai	d Min	er,	observer.]				

DAY.	Sept.	Oct.	Nov.	Dec.	DAY.	Aug.	Sept.	Oct.	Nov.	Dec.
1 2 3 4 5 5 6 7 7 8 9 10 11 12 12 13 14 15 16	3.60 3.60 3.61 3.68 4.38 4.09 3.66 3.72 3.56 3.72 3.56 3.72 3.62 3.62 3.60 3.61	3.66 3.66 3.83 3.74 3.78 3.96 3.90 3.80 3.83 3.82 3.74 3.68 3.68	3.78 3.72 3.76 3.87 4.08 4.22 4.12 3.82 3.74 3.82 3.90 3.78 3.77 3.76 3.83	3.72 3.72 3.68 3.70 3.73 3.86 3.80 3.73 3.83 3.73 3.86 3.87 3.83 3.73 3.86 3.87	17 18 19 20 21 22 23 24 25 26 27 28 29 30	3.76 3.67 3.74 3.68 3.64 3.62 3.62 3.62 3.59 3.59 3.59 3.58 3.58	3.64 3.61 3.62 3.59 3.61 3.60 3.60 3.56 3.56 3.56 3.57 3.69	3.62 3.66 3.62 3.64 3.62 3.64 3.68 3.76 3.80 4.41 4.13 3.80 3.76	3.72 3.70 3.80 3.84 3.80 3.73 3.77 3.74 3.68 3.73	3.90 3.88 4.02 3.90 3.77 3.88 3.82 3.82 4.12 3.74 3.78 3.78 4.14

SUMMARY OF DISCHARGE PER SQUARE MILE.

The following tables of summaries of discharge per square mile are given to allow of ready comparison of relative rates of run-off from different areas considered in this report. They show in a general way the seasonal distribution of run-off and the effect of snow, ground, surface, and artifical storage. But the most important fact worth noting is the almost entire lack of uniformity of agreement between any two stations. It indicates that the discharge of each stream is a law unto itself, and that all projects dependent upon stream flow, if they are to be developed along the safest and most economical lines, must be based on records of stream flow collected with great care over a long series of years as near the location of the project under consideration as possible:

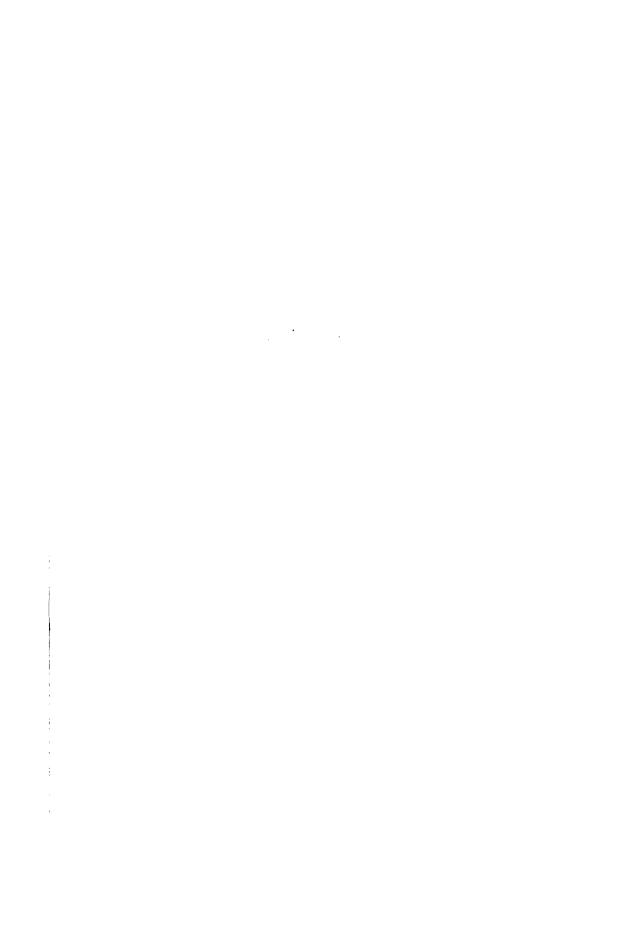
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Oet.	1.03	2 2 2 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	3823 3	8258
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1	Errata table of summary of discharge for 1910, page 373, 6th Annual Report of the State USE THESE VALUES.	October. November. December.	.617	
•	373, TBS.		2	
	barge for 1910, page 37. USE THESE VALUES.	August.	.872	
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APPENDIX F.

FINANCIAL STATEMENTS.

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APPENDIX F.

CLASSIFIED STATEMENT OF GENERAL OFFICE EXPENDITURES,

February 1, 1910, to December 31, 1910.

1910.	Receipts.				
Feb.	1. Unexpended balance of f priations			\$ 27,729	42
Oct.	1. By appropriation bill, Laws of 1910	-	•	41,680	00
				\$ 69,409	42
	${\it Disbursemen}$	ts.			
Salaries	of commissioners	\$20,833	31		
Salaries	of officers	8,731	66		
Expense	s of commissioners	2,393	12		
Expense	s of officers	596	56		
_	spenses, printing, stationery,				
furnit	cure, telegraph and telephone,				
postag	re, etc	2,474	80		
Rent of	offices	916	66		
Collectin	ng etatistics	415	00		
Stenogra	phic services	267	97		
	<u>-</u>			36, 6 29	08
Balan	ce, December 31, 1910			\$32,780	34

CLASSIFIED STATEMENT OF EXPENDITURES FOR RIVER IMPROVEMENT SURVEYS AND INVESTIGATIONS.

February 1, 1910, to December 31, 1910.

1910.	Receipts.	
Feb. 1. Unexpended bal	nce of appropriation	
under chapter	433, Laws of 1909 \$3,044 60	6
Dis	ursements.	
Salaries of engineering force	\$1,191 33	
Traveling, maintenance and	•	
expenses of engineers	158 46	
Legal expenses	1,298 94	
Publishing notices of hearing	s 58 75	
Postage, expressage, etc	337 18	
	3,044 60	6

CLASSIFIED STATEMENT OF EXPENDITURES FROM CANASERAGA CREEK IMPROVEMENT FUND.

September 8, 1910, to December 31, 1910.

1910.	Receipts.				
Sept.	8. Proceeds of bonds			\$208,013	3 3
Dec.	31. Interest on fund	• • • • • • • •		1,923	18
			-	\$209,936	51
	${\it Disbursemen}$	ts.		•	
Office eq	uipment and expenses	\$961	37		
Enginee	ring and legal services	6,018	74		
Travelin	g expenses	535	68		
Interest	on bonds	5,000	00		
	_	· · · · · · · · · · · · · · · · · · ·		12,515	79
Bal	ance, December 31, 1910		<u>-</u>	\$197,420	72

CLASSIFIED STATEMENT OF EXPENDITURES FOR SURVEYS AND INVESTIGATIONS UNDER STATE BOARDS AND COMMISSIONS LAW.

June 20, 1910, to December 31, 1910.

1910.	Receipts.				
June 20.	Appropriation by supply	bill, chan	oter		
	513, Laws of 1910		• • •	\$20,000	00
	Disbursemen	ts.			
Salaries of	f engineering force	\$2,100	73		
Traveling	and sundry expenses of	·			
engineer	8	223	25		
Maintenan	ce expenses of engineering				
force		40	07		
Office rent	and equipment	116	25		
Livery hir	e	24	50		
Telephone	and expressage	7	69		
		•••••		2,512	49
Balan	ce, December 31, 1910	• • • • • • • •		\$17,487	51

CLASSIFIED STATEMENT OF EXPENDITURES FOR GENESEE RIVER IMPROVEMENT.

September 24, 1908, to December 31, 1910.

1908.	Receipts.			
May	22. Appropriation by supply 466, Laws of 1908	•	\$ 25,000	00
	Disbursemen	ts.		
Salaries	of engineers	\$21,603 04		
Expens	es of engineers	2,131 05		
Test bo	rings	1,071 50		
	_		24,805	59
Ba	lance, December 31, 1910		\$ 19 4	41

CLASSIFIED STATEMENT OF EXPENDITURES FOR WATER POWER AND WATER STORAGE SUR-VEYS AND INVESTIGATIONS UNDER CHAPTER 569, LAWS OF 1907. (FULLER ACT).

February 1, 1910, to December 31, 1910.

1910.	Receipts.				
	Unexpended balance of f priations		• • •	\$ 3,37 4	05
June 20.	Appropriation by chapte of 1910	•		50,000	00
			_	\$ 53,374	05
	${\it Disbursemen}$	ts.			
Salaries of	engineering force	\$15,365	67		
Office rent	and equipment	961			
Maintenance	e expenses of engineer-				
ing force		590	59		
Traveling a	nd sundry expenses of				
engineers		1,155	48		
Livery and	boat hire	186	55		
Engineering	supplies	239	50		
Maps, blue	prints and photographs.	40	10		
Rental and 1	purchase of instruments.	125	29		
Stream gagi	ing in co-operation with				
U. S. Geo	ological Survey	4,922	13		
Rain gaging	;	429	61		
Printing an	d stationery	405	34		
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		· · · · · · · · · · · · · · · · · · ·		24,916	15
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ANNUAL BUDGET

FOR FISCAL YEAR, OCTOBER 1, 1911, TO SEPTEMBER 30, 1912.

On October 4, 1910, the Commission received a communication from the State Comptroller calling attention to chapter 149 of the Laws of 1910, which amended the State Finance Law in such manner as to require from each State Department an advance estimate in detail of all moneys, together with the reasons therefor, for which any general or special appropriation is desired at the ensuing session of the Legislature by such State Department.

The Comptroller's communication was accompanied by blank forms to be used in making out the statement and requested that it was desired to have the summary and schedules transmitted to the Comptroller's Department not later than October 22, 1910.

On October 24th, the Commission, by its President, forwarded to the State Comptroller, the estimates required.

The Comptroller's report to the Governor, under date of December 15th, contained the following statement:

"An item of \$25,000 is desired (by the Water Supply Commission) for surveys, plans, estimates, etc., as required by the State Boards and Commissions Law in connection with public waterways. No item for this specific purpose was appropriated by the last Legislature."

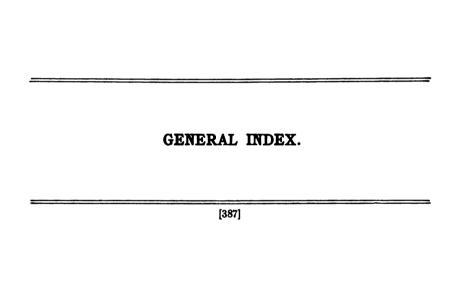
Presumably the item to which the Comptroller referred was an item of \$25,000 to cover surveys, investigations, reports, etc., with reference to public water supplies and river improvements for the benefit of public health and safety, and has nothing to do with public waterways. The 1910 Supply Bill appropriated \$20,000 for the identical purpose for which this appropriation is now requested.

An item of \$50,000 was requested to cover prospective water storage investigations and plans. The exact amount that will be required to carry on such work depends entirely upon what work the Legislature of 1911 may direct the Commission to do.

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